TASK FORCE ON STRATEGIC UNCONVENTIONAL FUELS

America's Strategic Unconventional Fuels

Oil Shale • Tar Sands • Coal Derived Liquids • Heavy Oil • CO_2 Enhanced Recovery and Storage

Volume II – Resource-Specific and Cross-cut Plans

Completed: February 2007
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IN RESPONSE TO SECTION 369 OF THE ENERGY POLICY ACT OF 2005 (P.L. 109-58)

Disclaimer

THE STRATEGIC UNCONVENTIONAL FUELS TASK FORCE

Honorable Samuel W. Bodman
Secretary of Energy
1000 Independence Ave SW
Washington, D.C. 20585

Dear Mr. Secretary:

The Task Force on Strategic Unconventional Fuels is pleased to submit its integrated strategy and program plan for *America's Strategic Unconventional Fuels*, as directed by Section 369(h)(5)(A) of the Energy Policy Act of 2005. This document builds on the report of *Initial Findings and Recommendations of the Task Force* that was completed in September 2006 and incorporates new recommendations resulting from the planning process and subsequent analyses.

This report is a product of a Task Force of eleven (11) members including the Secretaries of the Departments of Energy, Defense, and the Interior; the Governors of the States of Colorado, Kentucky, Mississippi, Utah, and Wyoming; and representatives of localities in those states that would be impacted by the development of the unconventional resources located therein. This report does not reflect agreement on all recommendations. However, the report lays out legitimate policy options which the Administration, Congress, States and local governments may consider. Nothing in this report reflects an official position of any member of the Task Force. The views and concerns of the Governors of the States of Colorado and Wyoming are articulated in prepared statements provided in an Appendix to Volume I of this report.

The Task Force concurs that the domestic and global fuels supply situation and outlook is urgent. Increasing global oil demand, declining reserve additions, and our increasing reliance on oil and product imports from unstable foreign sources require the Nation to take immediate action to catalyze a domestic unconventional fuels industry. Responsible development of America's oil shale, tar sands, heavy oil, coal, and oil resources amenable to recovery by carbon dioxide injection, to produce liquid fuels could reduce our dependence on imports and provide reliable and secure sources of strategically important liquid fuels. Aggressive development by private industry, and encouraged by government, could supply all of the Department of Defense's domestic fuels demand by 2016, and supply upwards of 7 million barrels per day of domestically produced liquid fuels to domestic markets by 2035. The Task Force has adopted that level as the objective for the Strategic Unconventional Fuels Program.

The Task Force has evaluated the extent and the potential contributions of each of these resources, and has developed a detailed plan for an integrated program to promote and accelerate their commercial development. In developing its recommendations and plan, the Task Force carefully considered and addressed the crosscutting issues, including environmental protection, water resources, socioeconomic impacts, markets, infrastructure, and carbon management, associated with concurrent development of unconventional fuels. The integrated program could achieve these goals in a sustainable and environmentally sound manner and mitigate against potential adverse impacts on affected states and communities.

This report presents development scenarios to be considered in establishing an unconventional fuels industry.

Respectfully submitted by:

TASK FORCE ON STRATEGIC UNCONVENTIONAL FUELS

CC: Distribution Attached

Distribution

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Committee on Armed Services

The Honorable Duncan Hunter
Ranking Minority Member

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GOALS AND OBJECTIVES

The oil shale program goal is to stimulate private industry development of a domestic oil shale industry while responsibly managing and mitigating environmental impacts, and protecting affected states and localities from adverse socio-economic impacts.

The oil shale development objective is the production of 2.5 million barrels per day (MMBbl/d) of shale oil by the year 2035.

A significant commitment by both industry and local, state, and the Federal government will be required to attain the development objective. This commitment to an effective private-public partnership underpins the comprehensive approach in this plan.

DEVELOPMENT SCHEDULE

The accelerated development schedule used to create this plan assumes that:

1. Oil prices will track the Energy Information Agency (EIA) low oil price case[1]. This low case assumes that oil prices reach a long-term equilibrium at about $35 per barrel,
2. A $5/Bbl production tax is applied to oil shale projects, and
3. High-risk cost-shared demonstration projects are undertaken to reduce the technical risks associated with the development of a new industry.

Using these assumptions, demonstration projects begin to produce shale oil in 2010. Daily production is low initially (about 40,000 Bbl/d) as the new technology is tested. Process improvements learned from these initial operations are then incorporated into expansion of the demonstration facilities. Production begins to accelerate as these improvements are implemented and, by 2014, shale oil production reaches 250,000 Bbl/d.

Success of the initial demonstration projects encourages additional industry development. By 2020, shale oil production reaches one million Bbl/d, 2 million Bbl/d by 2025, and 2.4 million Bbl/d by 2030.

The accelerated production schedule used to estimate the economic impacts of oil shale development is displayed in Figure II-1. The stair-step shale oil production pattern shown in this figure is similar to the development of the Canadian oil sands. Canadian oil sands production and the shale oil production schedule developed for this plan are plotted on a common time line in Figure II-2 beginning at year 0 and ending in year 30.

The similarity in the production profiles is apparent in this figure. From this comparison with the actual Canadian experience, the Task Force concludes that the accelerated shale oil production schedule is a reasonably achievable goal.

Analogy to Canadian Oil Sands

Development of Canada's oil sands and oil shale development in the United States have many common factors[2]; each offers a resource base that exceeds 1 trillion barrels and each has a similar average richness (25 gallon/ton). Oil shale will yield slightly more oil in terms of Bbl/ton processed (0.60 vs. 0.53) and a slightly higher quality of oil (38 vs. 34 degrees API).

Technology steps used to develop each resource are also similar: mining and ore preparation, extraction, coking and retorting, and upgrading[3]. Both crudes convert to high yields of liquid transportation fuels. The higher hydrogen content of shale oil and closer proximity to markets is expected to justify a market value at a premium when compared to West Texas Intermediate (WTI) grade conventional oil.

Figure II- 1. United States Oil Shale Development Schedule

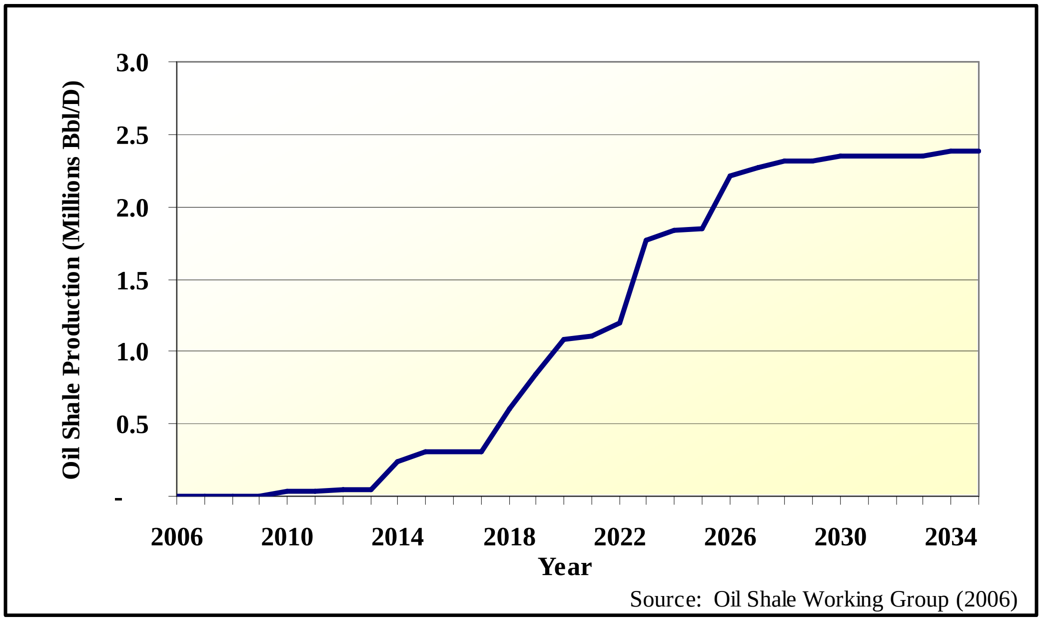
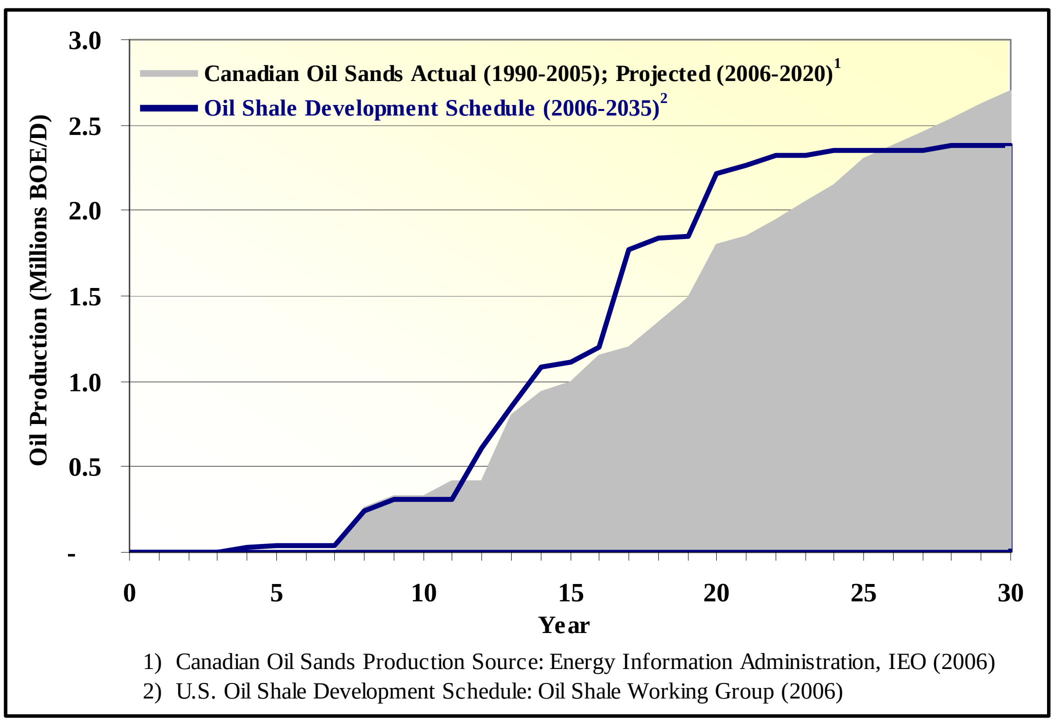


Figure II- 2. Canadian Oil Sands and U.S. Oil Shale Production Schedules



Canadian oil sands development was successfully undertaken as a cooperative effort between government and industry. The Comprehensive Report prepared by Canada's National Task Force on Oil Sands Strategies[4] was carefully considered in developing this oil shale plan. Common elements of the Alberta and Oil Shale Task Force Programs include providing access to resources, technology support, fiscal incentives, infrastructure support, regulatory streamlining, and environmental mitigation programs.

If both resources are developed according to plan, North America could be able to claim the largest oil reserves in the world. More importantly, the combined production that exceeds 5 million Bbl/d will serve to help fill in shortfalls from depleting world conventional petroleum resources.

ECONOMIC BENEFITS

The development of an oil shale industry provides potential public benefits. The Federal treasury, state and local governments, and the overall domestic economy will benefit from the direct contributions of a domestic oil shale industry and from the additional economic activity and growth that will result from industry development. Direct benefits can be measured in terms of:

- direct Federal revenues (from Federal taxes and the Federal share of royalties),
- direct state and local revenues (from state and local taxes plus the state share of Federal royalties),
- the value of avoided oil imports,
- employment, and
- contribution to gross domestic product (GDP).

The economic incentives put in place will determine the volume of oil shale that is produced. Three cases were used for this program plan to evaluate the effect of economic incentives on shale oil production and the accompanying volume of oil shale produced:

1. Base Case assumes a price floor of about $40/Bbl.
2. Measured Case assumes a price floor plus a $5/Bbl production tax credit.
3. Accelerated Case assumes a price floor, a production tax credit, and cost-shared demonstration projects undertaken to reduce the technical risks associated with the development of a new industry.

All analyses are based on the National Strategic Unconventional Resource Model (NSURM)[5] developed specifically for the Task Force by the DOE Office of Petroleum Reserves. The results are not intended to be a forecast of what will occur; rather, they represent estimates of potential benefits under the economic and technological assumptions of each case.

Federal and State Revenues

According to the results of the NSURM, direct Federal revenues generated in the base case would reach $0.9 billion per year by 2035. With the incentives introduced in the accelerated case, Federal revenues reach $4.2 billion per year by the end of the 30 year period of analysis.

Direct state revenues generated by the base case are $0.6 billion per year in 2035. In the accelerated case, state revenues reach $2.9 billion by 2035.

Total public sector revenues (the sum of direct Federal and state revenues) is shown in Figure II-3. Public sector revenues reach $1.5 billion for the base case and $7.0 billion per year for the accelerated case by 2035. Cumulative public sector revenues through 2035 total $152 billion for the base case and $402 billion for the accelerated case.

Figure II- 3. Annual Total Direct Public Sector Revenues ($ Billion)

Case	2015	2025	2035
Base	0.1	1.3	1.5
Measured	0.1	2.4	4.4
Accelerated	0.5	4.1	7.0

Value of Imports Avoided

The base case production of shale oil would replace imported oil at the order of $4.1 billion per year by 2035. The accelerated case would save the United States $22.4 billion per year by 2035 that would have otherwise been spent on imports.

Figure II-4 displays the value of imports avoided. Cumulative imports avoided through 2035 total $0.7 trillion for the base case and $1.8 trillion for the accelerated case.

Figure II- 4. Annual Value of Imports Avoided ($ Billion)

Case	2015	2025	2035
Base	0.4	4.2	4.1
Measured	0.4	10.3	12.9
Accelerated	2.8	17.4	22.4

Employment

Oil shale industry development will result in the addition of thousands of new, high-value, long-term jobs in the construction, manufacturing, mining, production, and refining sectors of the domestic economy. The NSURM model estimates direct petroleum sector employment based on industry expenditures. The model also approximates the total number of jobs that will be created in the petroleum sector.

Not all of the direct employment shown will be new jobs to the economy. Some will be filled by workers shifting from one industry sector to another. The jobs will not all be in the states where oil shale development sites are located. Other states that design and/or manufacture trucks, engines, steel, mining equipment, pumps, tubular goods, process controls, and other elements of the physical complex will also share in the jobs creation.

Accelerated oil shale development will create nearly 100,000 new jobs by 2035. The base case employment is significantly lower as shown in Figure II-5.

Figure II- 5. Annual Total Petroleum Sector Employment - Direct & Indirect (K Labor Years)

Case	2015	2025	2035
Base	2.9	20.7	20.8
Measured	4.3	49.6	59.8
Accelerated	16.8	82.5	99.7

Contribution to GDP

The direct contribution to the economy, as measured by the Gross Domestic Product (GDP), is significant. By 2035, the annual direct contribution is estimated at $26.0 billion for the accelerated case (Figure II-6).

The cumulative contribution to the GDP for the base case is $0.8 trillion. The cumulative direct GDP contribution for the accelerated case totals $1.9 trillion through the year 2035.

Figure II- 6. Annual Direct Contribution to GDP

Case	2015	2025	2035
Base	0.6	5.4	5.7
Measured	0.6	13.8	17.1
Accelerated	3.9	20.0	26.0

RESOURCE-SPECIFIC CONSIDERATIONS AND STRATEGIES

Western Oil Shale

America's massive endowment of western oil shale is the most concentrated hydrocarbon resource on earth (more than 2 million Bbl/acre in some locations) and offers the potential for significant, sustained domestic liquid fuel supplies. Issues that constrain development of the western oil shale resource by private industry include:

Ownership Issues: Nearly 80 percent of the western oil shale resources are on public lands. Leasing of public lands will be needed to open this resource for development.

Technology Issues: Neither government nor industry have demonstrated a process to retort oil shale on a commercial scale, either on the surface or in-situ. Demonstrations at commercially-representative scale are needed to resolve technical uncertainties.

Investment Risk Issues: Profitable operations from oil shale development cannot be reliably predicted due to uncertain development costs and future oil prices. Incentives will help to reduce the economic risks of development.

Environmental Issues: Impacts from oil shale development will be local and regional in nature. Plans are needed to mitigate adverse environmental outcomes.

Infrastructure Issues: Roads, pipelines, and other infrastructure are needed to support development. An integrated local and regional infrastructure support plan is needed.

Socio-economic Issues: Rapid growth will greatly expand demand for municipal and human services. A plan is needed to assure municipal funds are available when needed.

This plan addresses each issue in the comprehensive manner needed to remove or reduce its significance as a constraint.

Eastern Oil Shale

Oil shale deposits underlay much of the eastern United States, ranging from Mississippi to New York. These deposits are not as concentrated as the western shale deposits and they contain a different type of organic carbon than the western shale. As a result, conventional retorting of eastern shale yields less shale oil and a higher carbon residue as compared with the western shale. Because of these differences, industry interest in oil shale commercialization has focused on the richer, more concentrated oil shale deposits of the western states.

Nevertheless, Eastern shale has the potential to become an important addition to the nation's unconventional fuel supplies. Near-surface mineable resources are estimated at 423 billion barrels[6]. Ninety-eight percent of these accessible deposits are in Kentucky, Ohio, Tennessee, and Indiana. One area in particular, the Kentucky Knobs region, has accessible resources of 16 billion barrels, at a minimum grade of 25 gal/ton. With processing technology advances, for example the addition of hydrogen to the retorting process, potential oil yields could approach those of the western shale.

Eastern shale has some advantages over the western shale. First, eastern shale is closer to major demand centers and this will reduce the transportation costs. Second, the liquid product may be movable by barge to a refinery for processing. This may eliminate the need for local upgrading and would eliminate the need to construct large new pipelines. Third, since the resource is diverse, environmental issues associated with eastern shale development will not likely have significant regional impacts. Fourth, in the more populated eastern area, infrastructure and socio-economic issues will not likely be as significant as compared with western oil shale development. Fifth, since these states have numerous coal mines and industrial plants, public acceptance and permitting of oil shale facilities may be easier.

Eastern oil shale development has not received the same focused attention as the western resources. To remedy this, a comprehensive study should be undertaken of the eastern oil shale potential. This study should lead to the identification of challenges that constrain eastern oil shale development and plans that can stimulate commercial development. One focus of the study should be on engineering and economics associated with the development of selected high-potential development areas, such as the Kentucky Knobs region.

MAJOR PROGRAM ELEMENTS

Issues associated with oil shale development are detailed in Volume III – Oil Shale Resource and Technology Profile[7]. The critical issues contained in the Profile are summarized below. In addition, a plan and schedule needed to resolve each issue is proposed and discussed. The oil shale program is arranged under the following categories:

- Resource access,
- Technology advancement and demonstration,
- Development economics and investment stimulation,
- Environmental protection,
- Regulatory and permitting,
- Infrastructure, and
- Socio-economic planning and impact mitigation.

For each program category, the objective, strategy, rationale for action, planned activities, and schedule are discussed.

Resource Access

Objective: Assure access to oil shale resources on public lands sufficient to meet industry needs and national goals.

Strategy: Establish a Commercial Leasing Program to make geologically prospective oil shale on public lands (Federal and state) available to industry for leasing and sustainable development on an equitable basis.

Rationale for Action: Over the years, oil companies have accumulated significant oil shale lease holdings on private lands located near the southern margins of Colorado's Piceance Creek Basin. These holdings are located near where the oil shale outcrops to the surface. At least three oil shale tracts on private lands have sufficient contiguous resources to support commercial-scale operations of up to 400,000 Bbl/d[8].

In contrast, public lands are concentrated near the center of the Piceance Creek Basin where the oil shale thickness increases from 200 feet at the margins to over 1,500 feet near the depositional center of the Basin. With the increased thickness, there is a corresponding increase in the oil shale richness. Oil shale resources on public lands are thicker and richer than those of private land holdings. Public lands also include areas where the Mahogany Zone can be readily surface-mined. These lands are currently not available and should be made so for nomination by private industry interested in their development.

Private lands are held by only a few companies. These companies will be reluctant to develop their lands first, while the possibility exists that the higher-grade resources on public lands will be available to potential competitors. The nation cannot count on these individual companies to make corporate decisions to begin development. However, leasing of public lands will create a competitive environment that will interest additional investors. Leasing will therefore help stimulate oil shale development on both public and private lands.

Under this plan, oil shale resources on public lands will be made available for development in a predictable and timely manner. This will facilitate industry long-term planning and eliminate resource availability as a constraint.

Resource Access Plan:

1. **Develop Leasing Strategy**: The Task Force recommends that the Department of Interior (DOI) analyze ownership patterns to determine optimal lease block configurations. The initial effort should concentrate on land exchanges that will enable efficient development. Subsequent efforts should concentrate on competitive leasing. Development areas should be

sufficient in size to support projects operating at full commercial scale for durations of at least 30 years. The DOI should consider an open nomination process similar to existing processes for oil, gas, and coal leasing.

2. **Develop Lease Rules to Assure Maximum Economic Resource Recovery**: Since oil shale concentration varies widely, the Task Force recommends that DOI develop lease rules that require maximum oil shale recovery consistent with foreseeable economic conditions. This will allay the temptation to "high grade" the resource to the detriment of future production.

3. **Resolve Use Conflicts**: Natural gas production and other surface uses may conflict with oil shale development. The Task Force recommends DOI work with industry/stakeholders to develop mineral development plans including all resources.

Resource Access Activities:

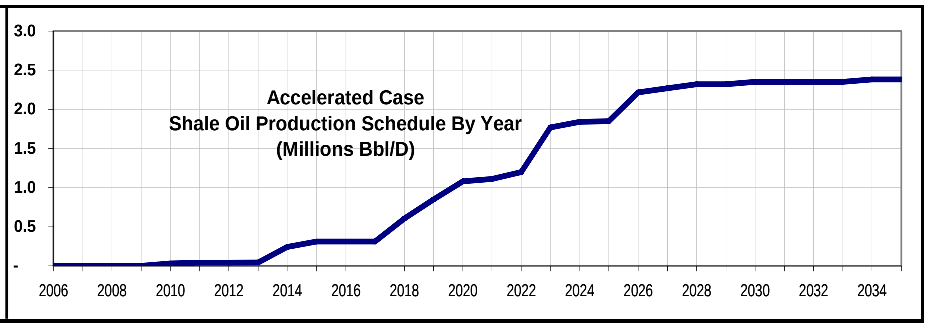
1. Prepare and implement leasing strategy in consultation with all stakeholders.
2. Prepare leasing rules that maximize oil shale resource recovery.
3. Prepare use plans that alleviate conflicts over minerals or surface uses of land.
4. Identify and complete land exchanges to comprise logical development tracts.
5. Initiate competitive leasing activities.

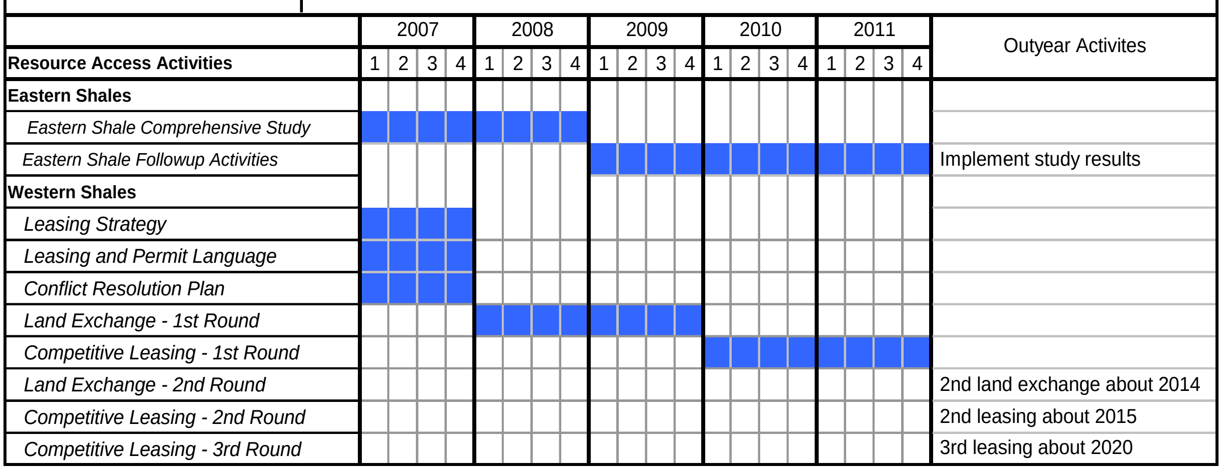
Resource Access Schedule:

The resource access activities and schedule are presented in Figure II-7.

Figure II- 7. Resource Access Activities and Schedule

Objective: Assure access to oil shale resources on public lands sufficient to meet industry needs and national goals.
Strategy: Make unconventional fuels resources on public lands (federal and state) available to industry for leasing and sustainable development on an equitable basis.
Lead: DOI/BLM
Support: SPR/NPOSR
Affected States





Technology Advancement and Demonstration

Objectives: Enable near-term application of viable current technology. Improve technology performance and efficiency to drive down costs. Accelerate industry development of next-generation technology.

Strategy: Craft a fast-track technology program to attract capital investments. Facilitate demonstration of efficient first generation technologies while carrying out parallel efforts to develop and demonstrate the next generation technology.

Rationale for Action: Federally sponsored oil shale research dates to World War II when Congress authorized the construction and operation of demonstration plants to produce liquid fuels from oil shale. Under this authorization, the Bureau of Mines constructed, operated, and maintained the Anvil Points oil shale experimental station near Rifle, CO to further oil shale mining and surface retorting technologies.

The Bureau designed and opened an oil shale mine, designed, constructed, and operated a vertical kiln technology, and successfully refined the shale oil produced. Upon the conclusion of the government research, the Anvil Point facility was leased to an industry consortium to further develop the Bureau's technology. This research resulted in an improved vertical gas combustion surface retorting technology known as the Paraho Retorting Process. Experimental work continued through 1982. The largest Paraho retort constructed and successfully tested processed 300 tons/day (TPD) of oil shale.

A commercial retort will use 10,000 to 20,000 TPD of raw oil shale, about 30 to 60 times more than the largest tested Paraho unit. Only one effort has ever been made in the U.S. to construct and operate this size retort, and the effort failed due to technical issues[9].

This commercial development effort was the final test of a retorting technology developed by Union Oil Company of California (UNOCAL). The approach was invented in the 1940's and systematically moved toward commercial demonstration. By 1983, UNOCAL constructed the first full-scale commercial module designed to process 13,000 TPD of oil shale.

Supported with Federal loan and price guarantees, UNOCAL attempted to operate the plant over 40 times between 1983 and 1991. Each time, the plant was shut down for technical modifications. While in operation, UNOCAL produced 4.6 million barrels of shale oil that was successfully marketed. However, the facility achieved only about 25 percent of the commercial design rate. Overall, the UNOCAL retorting technology proved to be too difficult to scale up to commercial operations. Experimental work was terminated in 1991, the plant was decommissioned, and the site was reclaimed.

Research at the government's Anvil Points Facility and by private industry on private lands has clearly shown that oil shale can be mined at commercial rates, crushed and sized for retorting, liquids recovered, shale oil refined into products, and those products used to fuel Air Force planes and Navy ship and land vehicles. The only step not proven at commercial-scale is surface retorting.

Similarly, in-situ operations that involve heating the oil shale, moving produced shale oil gases to a producing well, lifting them, and site reclamation have not yet been proven on a commercial-scale in the United States.

Both government and industry are aware of past failures to achieve commercial operations. The government withdrew support from oil shale development in 1985 when Congress abolished the Synthetic Liquid Fuel Program and industry withdrew its efforts shortly thereafter.

Despite the termination of commercialization efforts in the 1980s, the numerous technologies developed for surface and in-situ production of shale oil in that era still hold significant promise. Technology advances achieved since 1980, oil shale experience in other countries, and expectations for sustained higher oil prices all contribute to an improved outlook for oil shale development.

Even with an improved outlook, industry will be reluctant to move once again toward commercial oil shale development on the pace demanded to meet urgent energy requirements and public policy goals of reducing import dependence. The Task Force therefore concludes that government support is necessary to achieve commercial oil shale production in a reasonable time period.

Under this plan, the government will accelerate development by supporting cost-shared demonstrations and by conducting research to provide technical assistance.

Technology Plan:

1. **Cost Shared Demonstration Projects**: The Task Force recommends that DOE identify existing oil shale technologies that are promising for demonstration at commercially-representative scale and that have a high probability of leading to commercial production. DOE should select up to four demonstration projects (including at least one surface and one in-situ) among the states of Utah, Colorado, and Wyoming for cost sharing. Consistent with the provisions of the Energy Policy Act of 1992, Federal cost-sharing should not exceed forty-nine percent (49%) of the capital and operating costs of the demonstration project, including environmental controls.

2. **Provide Technical Assistance**: The Task Force recommends that DOE provide technical and environmental assistance to industry to help overcome identified technical challenges. National laboratories and other facilities operated or supported by the DOE have substantial, directly relevant skills and expertise that should be made available to industry to resolve technical challenges posed by various oil shale technologies, on a cost-shared basis.

   Concurrent with demonstration and commercialization of near-term technologies, efforts should be initiated to advance these concepts and processes to develop more efficient "next-generation" technologies. A suite of highly-focused and prioritized research efforts should be defined and supported.

Technology Activities:

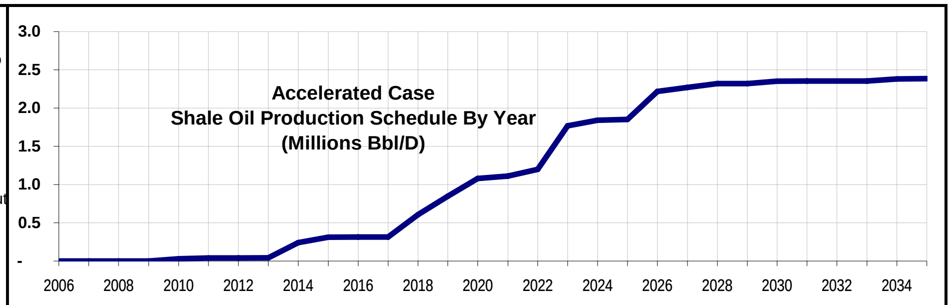
1. Identify existing oil shale technologies that are promising for demonstration at commercially-representative scale and that have a high probability of leading to commercial production.
2. Develop a plan to establish technology support centers in Utah, Wyoming, and Colorado.
3. Develop and implement a process for providing cost-shared technical assistance from the DOE National labs/facilities.
4. Identify next-generation research priorities; issue competitive cost-shared procurements for R&D projects.
5. Develop and issue competitive procurements for multiple rounds of cost-shared demonstration projects.

Technology Schedule:

Figure II-8 displays the technology advancement and demonstration activities and schedule.

Figure II- 8. Technology Advancement and Demonstration Activities and Schedule

Objective: Enable near-term application of viable current technology. Improve technology performance and efficiency to drive down costs. Accelerate industry development of next-generation technology.
Strategy: Craft a fast-track technology program to attract capital investments. Facilitate demonstration of efficient first generation technologies while carrying out parallel efforts to develop and demonstrate the next generation technology.
Lead: SPR/NPOSR
Support: National Labs/FE/R&D



	2007				2008				2009				2010				2011				Outyear Activities
Technology Advancement Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Technology Identify and Assess																					
Technology Center Feasibility																					
Technical Assistance from Labs																					Continue technical assistance
Next Generation RD&D																					Continue RD&D
Cost-Shared Demo's; 1st Round																					None scheduled
Cost-Shared Demo's; 2nd Round																					None scheduled

Oil Shale Development Economics and Investment Stimulation

Objective: Allow fuels projects to compete favorably with other investment options. Stimulate industry investment in fuels projects. Minimize risks to public treasuries. Assure market for initial shale oil production.

Strategy: Identify, analyze, and propose a fiscal regime of royalty, tax, and pricing structures that will attract private development capital.

Rationale for Action: Oil shale development is characterized by high capital investment and long periods of time between expenditure of capital and the realization of production revenues and return on investment. Revenues are uncertain because future market prices for shale oil and byproducts are unknown. Therefore, a key economic barrier to private development is the inability to predict when profitable operations will begin. The economic risk associated with this uncertain outcome is magnified by the unusually large capital exposure, measured in billions of dollars per project, required for development.

After initial commercial operations establish predictable cash flow forecasts, project development and expansions by private industry are expected to continue at a pace dictated by normal economic calculations. Such decisions will be based on the then well-defined costs of oil shale production compared with alternative investments.

The development economics issue is short-term. Once commercial operation is successfully demonstrated, capital and operating costs will fall as operations become more efficient and the industry matures and learns how best to economically develop the resource. If oil prices are maintained at only current levels, second and third generation technology will continue to improve, profitability will increase, and the relative economics of oil shale development will become more attractive. Over the longer-term, improving economic operations will attract the additional investment capital needed to expand operations just as it has for oil sands development in Canada.

Similarly, initial shale oil production volumes from demonstration facilities and early commercial operations will be relatively small, but will require a market. The Department of Defense is proposing to test a variety of fuels from domestic unconventional sources for military use and is authorized under the Energy Policy Act of 2005 as well as the

Defense Production Act to enter into purchase agreements for such fuels.

This plan addresses the short-term actions needed to help reduce of initial risk associated with oil shale development.

Development Economics Plan:

1. **Prepare a Plan to Assure a Market for Initial Shale Oil Production**: The economic risk of an oil price collapse would be largely eliminated if the government enters into a contract to purchase domestic shale oil at a guaranteed minimum price ($/Bbl). Both the DoD and the DOE (Strategic Petroleum Reserves) have ongoing oil procurement programs that could be employed to assure a stable future market. The DoD program purchases finished fuels to support military operations. The DOE purchases crude to be stored in the Strategic Petroleum Reserve. The Task Force recommends that government use its existing ongoing procurement programs and authorities to help assure a market for initial oil shale development.

2. **Recommend an Effective Suite of Risk-Reduction Incentives**: The Task Force identified a production tax credit as one of several incentives that could have a significant effect on stimulating investment in oil shale development. Properly developed, this incentive could be revenue neutral to the government. Shale oil production will generate royalty income over the life of a typical project. Providing a production tax credit equal to the royalty income results in no net cost to the government as compared with continuing to import foreign oil, which generates no income for the government. Royalty relief could be effectively used early in the development and removed as dictated by production economics. However, the royalty structure for mined oil shale ore, or for liquids and gases produced from oil shale through in-situ processes, has not yet been defined by law or regulation. This royalty structure must be defined to enable effective royalty incentives for early commercialization projects, to facilitate estimates of future revenues to the states, and to determine the net revenue neutrality of alternative risk-reduction incentives.

Development Economics Activities:

1. Establish the royalty rate structure for surface oil shale development and for shale oil and products produced in-situ.

2. Examine the benefits and costs of using Federal procurement of crude and crude derived products to help create a stable market for initial shale oil production. Market assurance programs should include, but not be limited to, DoD programs to procure military fuels and the DOE program to procure oil for the Strategic Petroleum Reserve.

3. Examine the benefits and costs of alternative tax incentives to stimulate initial oil shale development. Incentives should include, but not be limited to, production tax credit, accelerated depreciation, investment tax credit, and a depletion allowance.

4. Implement high potential incentives: the Task Force will prepare legislative recommendations as needed to implement high priority incentive recommendations.

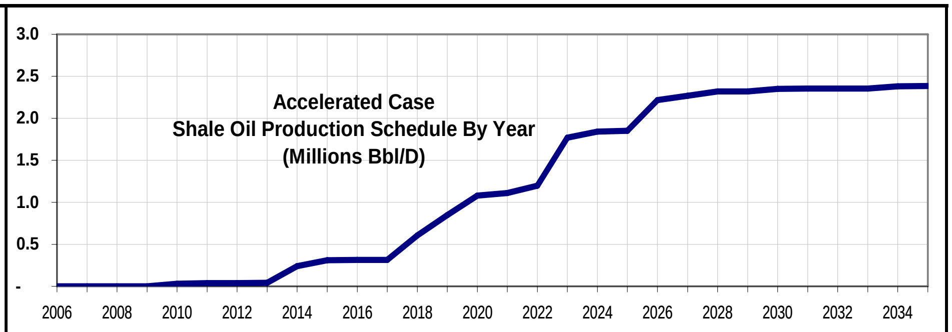
5. Conduct supporting economic analyses to refine economic incentive recommendations.

Development Economics Schedule:

The development economics activities and schedule are presented in Figure II-9.

Figure II- 9. Oil Shale Development Economics and Investment Stimulation Activities and Schedule

Objective: Allow fuels projects to compete favorably with other investment options. Stimulate industry investment in fuels projects. Minimize risks to public treasuries. Assure market for initial shale oil production.
Strategy: Identify, analyze, and propose a fiscal regime of royalty, tax, and pricing structures that will attract private development capital.
Lead: NPOSR/SPR
Support: U.S. Treasury & DOI & DoD Affected States



	2007				2008				2009				2010				2011				Outyear Activities
Development Economics Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Establish Royalty Rate for Oil Shale		■																			
Shale Oil Purchase Agreements			■																		
Federal/State Economic Incentives				■																	
Economic Incentive Implemention					■	■	■	■	■	■	■	■									
Supporting Economic Analyses	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	As needed to support program.

Environmental Protection

Objective: Enable industry development and operations while meeting or exceeding public standards and requirements for environmental protection.

Strategy: Design and monitor oil shale facilities that minimize air, land, water, and wildlife impacts. Craft and evaluate an effective carbon management strategy. Craft and evaluate strategies for water resource management. Support research focused on reducing, managing and mitigating environmental impacts.

Rationale for Action: Congress, under the Energy Policy Act of 2005[10], directed the Department of the Interior (DOI) to prepare a Programmatic Environmental Impact Statement (PEIS) for commercial leasing of oil shale and tar sands. This impact statement is currently being prepared. It will analyze and document the environmental, social, and economic issues associated with alternative development approaches.

The 2005 Congressional directive represents the first steps toward leasing of oil shale lands since the DOI 1973 Prototype Oil Shale Leasing Program. Environmental issues identified and studied at that time included the impacts of development on the land, on water resources, on air quality, on fish and wildlife habitat, on grazing and agricultural activities, and on recreation and aesthetic values. Because no commercial development had ever taken place to verify the extent of the environmental impacts, the DOI required each lease holder to prepare a Detailed Development Plan (DDP) that included site-specific environmental control plans.

A key feature of the DDP was the requirement to collect and document two years of environmental data that would be used as a baseline to measure the actual impacts of development. Extensive environmental information was collected, for example, the number of mule deer, counts of meadow larks in riparian habitats, sulfur levels in alluvial wells, and air quality from monitoring stations constructed around each site. One lease holder submitted 59 volumes of data documenting baseline conditions over a two year period. Lessees also prepared a two-volume Socio-Economic Assessment and Impact Analysis of oil shale development at their site. Public hearings on the development plans were held, improvements in the approach incorporated into a final plan, and the final plan formally approved in a Decision Document prepared by the DOI. Development was then allowed to proceed with the impact of development monitored.

The DOI has developed and implemented proven processes to analyze and to control mineral development on public lands, including oil shale. Public comments on the current effort to develop an oil shale and tar sands PEIS have already been received and will be incorporated into the analysis. A draft PEIS is scheduled late in 2006, the Final PEIS in the spring 2007, and the Record of Decision in summer 2007.

The Task Force will support the DOI leasing efforts with environmental research targeted to mitigate regional issues associated with water availability and air quality. The Task Force will develop and implement an aggressive outreach program to gather information needed to prepare an environmental plan that meets community objectives.

Environmental Plan:

1. **Support preparation of the Programmatic Environmental Impact Statement (PEIS) for commercial leasing of oil shale and tar sands.** As a part of this support, the Task Force recommends that extant environmental data collected under Interior's prototype leasing program be analyzed and the results used to help develop research needed to mitigate adverse environmental impacts. Interrupted research on water reuse and the beneficial uses of spent shale should be reactivated.

2. **Develop an Environmental Management Plan.** Consistent with the findings of the PEIS and other research, an environmental management plan should be developed that considers the impacts of phased oil shale development on an industry-wide basis, identifies effective management strategies for industry and government, and defines approaches for monitoring, analysis, and mitigation of environmental concerns. An aggressive outreach program should be implemented designed to systematically gather information needed to support the plan development.

3. **Craft a carbon management plan to address CO_2 emissions.** Carbon dioxide can be captured, but current amine-absorption technology is both energy intensive and costly. Capital expenditures and operating costs for CO_2 capture will depend on the type of retort and the concentration of carbon dioxide in the exhaust stream. The carbon dioxide stream must be treated for transport to beneficial uses such as improved oil or gas recovery or shipment via pipeline to locations for sequestration. The Task Force recommends that an effective carbon management plan be developed that combine the desirability of mitigating the incremental production CO_2 of with the industrial use of this gas.

4. **Craft and evaluate strategies for water resource management.** Water use and water quality will continue to dominate western regional concerns about oil shale development. The Task Force recommends that a program for western water resource management be developed and implemented.

Environmental Activities:

1. Complete the PEIS process, including a record of decision.

2. Develop Oil Shale Environmental Management Plan for industry-wide monitoring and mitigation of impacts.

3. Evaluate Prototype Oil Shale Leasing Program environmental data to help focus environmental research and support activities.

4. Define and implement an Oil Shale Environmental R&D plan to support research and technology development focused on mitigation of environmental impacts associated with oil shale development.
5. Prepare a carbon management plan for oil shale in coordination with the development of a cross-cutting carbon management strategy for unconventional fuels development.
6. Prepare a water resource management plan in coordination with the development of a cross-cutting water resource strategy for unconventional fuels development.

Environmental Schedule:

The environmental activities and schedule are presented in Figure II-10.

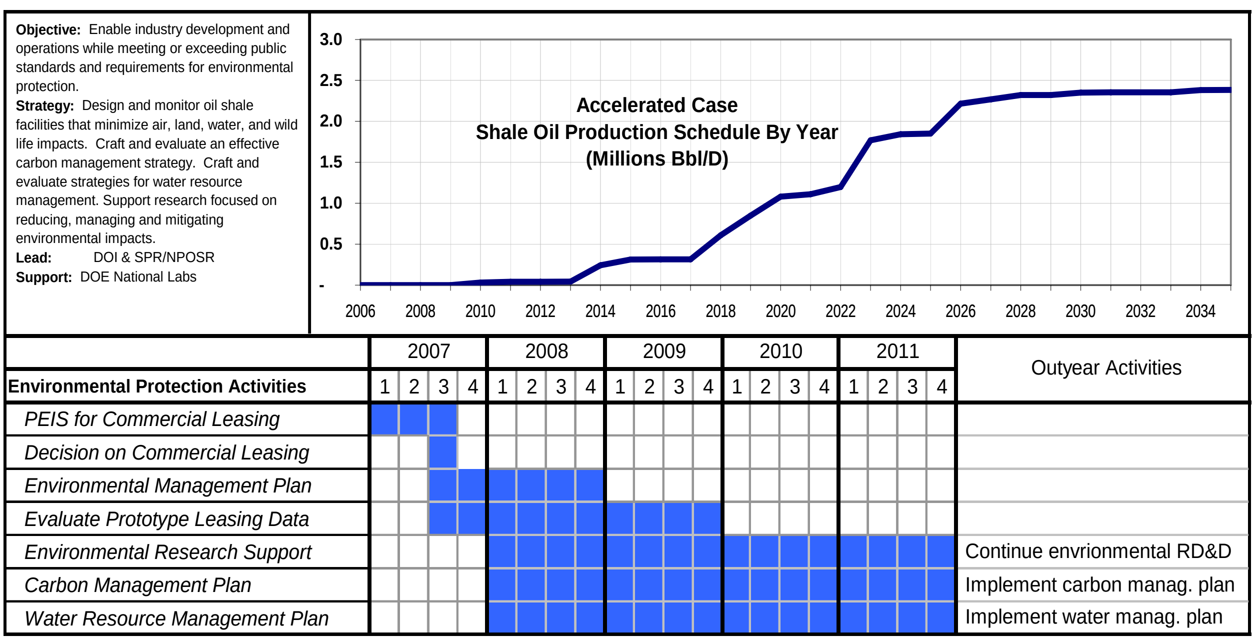
Regulatory and Permitting

Objective: Provide an inclusive regulatory system and review process that allows expeditious development and a predictable schedule for permitting.

Strategy: Streamline permitting to accelerate development while ensuring regulatory compliance. Provide an effective means for resolving disputes.

Rationale for Action: Oil shale plants are required to obtain dozens of permits and approvals, involving all levels of government (local, state, and Federal). While environmental laws have matured and permitting processes have improved, permitting delays remain a major risk for large oil shale projects. Permitting delays can postpone entire projects and, in turn, threaten their economic viability.

Figure II- 10. Environmental Activities and Schedule



The Task Force recommends that the concerned Federal, state, and local agencies cooperatively undertake a review of regulatory requirements and streamline the permitting process. It is not the intent of this effort to circumvent or eliminate any state, Federal, or local environmental requirement or standard. It is expected that resources and personnel will be provided for inspection to ensure compliance with law, regulations, and permit requirements. The goal is to make the process more efficient and improve the predictability of the timelines required to secure permits before construction or operation can begin.

Regulatory/Permitting Plan:

1. **Review and document existing standards and permit requirements at the local, state, and Federal level.** Prepare and publish a "roadmap" of current permitting processes and timelines in major oil shale states and Federal permitting processes.

2. **Develop a methodology to streamline oil shale permitting.** Using the roadmap developed above, develop and publish a methodology to streamline permitting. As a part of this effort, identify and consider approaches for delegated authorities, or joint or concurrent review. Focus on web-based applications and responses.

3. **Implement the improved permitting process** on a trial basis and update the methodology as needed, based on user experience.

Regulatory/Permitting Activities:

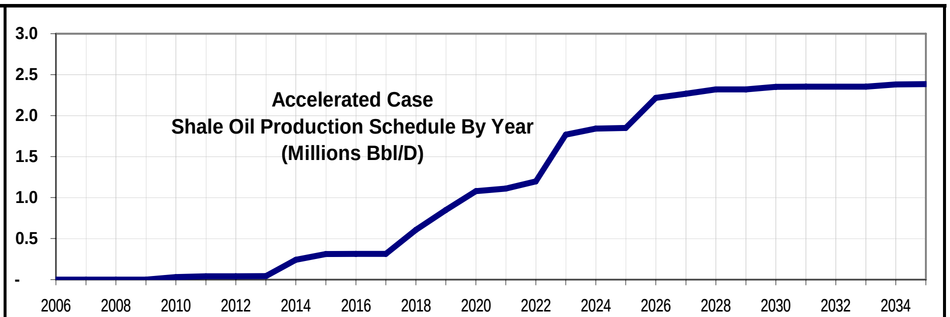
1. Review existing local, state, and Federal standards and permit requirements
2. Develop streamlined permitting process.
3. Conduct a trial run of the streamlined permitting process.
4. Implement the new permitting process, making incremental improvements over time.

Regulatory/Permitting Schedule:

The regulatory/permitting activities and schedule are presented in Figure II-11.

Figure II- 11. Regulatory/permitting Activities and Schedule

Objective: Provide an inclusive regulatory system and review process that allows expeditious development and a predictable schedule for permitting.
Strategy: Streamline permitting to accelerate development and ensure regulatory compliance. Provide an effective means for resolving disputes.
Lead: SPR/NPOSR
Affected States
Support: DOI & EPA



	2007				2008				2009				2010				2011				Outyear Activities
Regulatory and Permitting Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Review Stds. & Permit Requirements		■	■	■																	
Streamline Permitting Proccess			■	■	■	■	■														
Trial Run of Improved Process					■																
Implement Permitting Process						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Continuing permitting support.

Infrastructure

<u>Objective</u>: Provide proper planning to assure that infrastructure is adequate to support industry development and economic growth.

<u>Strategy</u>: Evaluate requirements and create an integrated local and regional infrastructure plan that supports development, realizes synergies, and avoids duplicating costs.

<u>Rationale for Action</u>: Oil shale development in Colorado, Utah, and Wyoming requires infrastructure to support industry development. Shale oil, as produced, will not meet pipeline requirements without upgrading. A regional upgrading facility would provide cost benefits to the companies, especially the smaller producers, and provide environmental benefits to the region by reducing the number of point emission sources.

Existing infrastructure is expected to be adequate for the first commercial demonstrations to move the locally upgraded shale oil to refineries by truck or by existing pipelines. Utah and Wyoming refineries will likely absorb first shale oil production. However, growth of the oil shale industry will begin to outstrip regional pipeline and refining capacity.

One new pipeline will be required by 2012 to move at least 500,000 Bbl/d to refineries outside the region. Initial shale oil movement may be toward West Coast refineries. However, as the industry continues to grow, a pipeline will be required by 2017 to move the oil to larger demand centers in the Midwest and, through existing interstate lines, to the Nation's largest concentration of refiners along the Gulf of Mexico. New pipelines will need to be permitted on a timely basis to support a smooth industry expansion.

The Departments of Energy, Interior, Agriculture, and Defense (the Agencies) are preparing a draft Programmatic Environmental Impact Statement (PEIS) to identify the impacts associated with designating energy corridors on Federal lands in eleven western states. Energy corridors may contain oil, gas, and hydrogen pipelines and electricity transmission facilities. The Agencies are preparing the PEIS at the direction of Congress, as set forth in Section 368 of the Energy Policy Act of 2005[11]. Based upon the information and analyses developed in the PEIS, the Agencies will designate energy corridors by amending their respective land use plans. This effort will improve the ability to effectively permit new shale oil pipelines.

Water is needed to support the industry and associated economic development. Water rights are real property that can be bought and sold. Many of the companies active in the 1970s and 1980s secured water rights needed for initial operations. Industry will compete economically for water, but economic and /or dislocations caused by this competition will need to be managed.

Natural gas for process heat and upgrading is produced in ample supply locally. Some technologies may require additional electric power generation capacity. Natural gas or coal-burning facilities may need to be constructed and/or existing facilities expanded.

As many as 100,000 direct and indirect new jobs could be created by the construction and operation of a 2 million barrel per day shale oil industry. Oil sands operations in Canada will likely be nearing a development peak when oil shale development in the United States begins to require a large labor pool. Skilled labor needed for oil shale development may therefore be available by transfer from similar operations in Canada. The status of both oil sands and oil shale development will need to be assessed over time and labor support plans developed.

<u>Infrastructure Plan:</u>

1. **Evaluate and assess the infrastructure requirements** for developing the western

oil shale resources, including moving products and byproducts to likely refinery locations in the West, Midwest, or Gulf Coast.

2. **Prepare an integrated local and regional infrastructure support plan**. The plan would anticipate industry infrastructure support requirements for pipelines, water, coal, labor, and other resources and how these requirements can be supported in a way that realizes regional synergies and avoids duplicating costs. Coordinate with the development of an integrated cross-cut infrastructure strategy and plan.
3. **Evaluate feasibility of regional upgrading facility**. This facility would accept shale oil from any producer and upgrade it to pipeline quality. Feasibility would include likely demand for upgrading services, site selection, costs, and funding sources.
4. **Assess pipeline requirements and support permitting of major pipelines**.

<u>Infrastructure Activities:</u>

1. Assess infrastructure requirements.
2. Prepare an integrated local and regional infrastructure support plan.
3. Evaluate feasibility of a regional upgrading facility
4. Support permitting of major pipelines

<u>Infrastructure Schedule:</u>

The infrastructure activities and schedule are presented in Figure II-12.

Markets

<u>Objective</u>: Align fuels production with expected market demand.

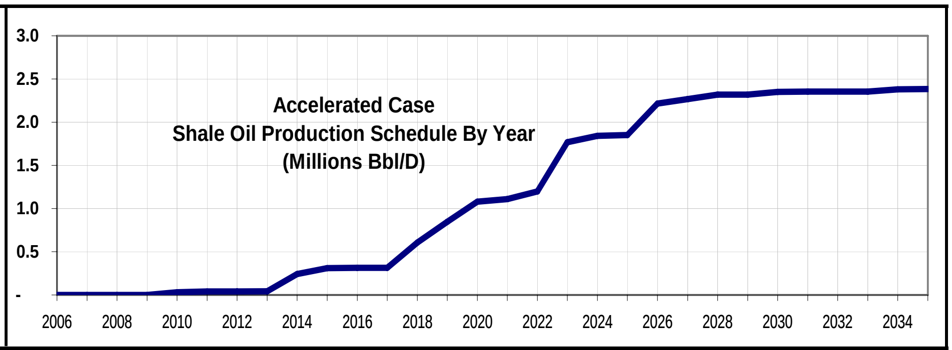
<u>Strategy</u>: Understand fuels markets, demand for shale oil, refinery capacities to accept and use shale oil. Provide support to the Department of Defense Clean Fuels Initiative.

<u>Rationale for Action:</u> The decision to lease public oil shale lands will have a major impact on oil shale development. The Task Force will evaluate alternative ways it can assist the smooth flow of unconventional crude and products into commercial markets.

In addition to commercial markets, the Office of the Secretary of Defense has established a Clean Fuel Initiative and is moving to define and to develop a single Battlefield Use Fuel of the Future (BUFF) for use in ground vehicles

Figure II- 12. Infrastructure Activities and Schedule

Objective: Ensure adequacy of infrastructure to support industry development and economic growth.
Strategy: Evaluate requirements and create an integrated local and regional infrastructure plan that supports development, realizes synergies, and avoids duplicating costs.
Lead: SPR/NPOSR
Support: Affected States
DOI



	2007				2008				2009				2010				2011				Outyear Activities
Infrastructure Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Assess Infrastructure Requirements																					
Integrated Infrastructure Support Plan																					Support infrastructure planning
Feasibility of Regional Upgrading																					
Major Pipeline Permits																					2nd pipeline needed by 2017

and airplanes. To implement this initiative, DoD is crafting a fuel specification that meets its technical requirements for tactical vehicles. The Task Force will support the development of the fuel specification and work with industry to obtain fuels for military testing.

Market Plan:

1. **Analyze and assess current and potential public and private markets for shale-oil fuels.** Building on the successful effort by the DoD to identify a specification that meets its fuel requirements, the Task Force proposes to review other Federal and state markets that may be able to utilize oil-shale derived products and prepare legislation, as appropriate, that will use public markets to help stimulate the development of shale oil products.

2. **Analyze and characterize existing and planned transportation and refining infrastructure and capacities to accept new shale oil feedstocks.** As a part of this task, determine the mix of refineries and refinery requirements needed to absorb expected shale oil production. Identify issues associated with dislocations between feedstocks, transport, refining, and end use markets.

3. **Develop a plan that addresses any bottleneck than may hinder the smooth flow of shale oil into commercial markets.** Assess the location and rate of oil shale development. Prepare a plan that recommends government actions that would support the movement of products to commercial markets. Provide supporting data and input to the markets cross-cut analysis that considers all strategic unconventional fuels.

Markets Activities:

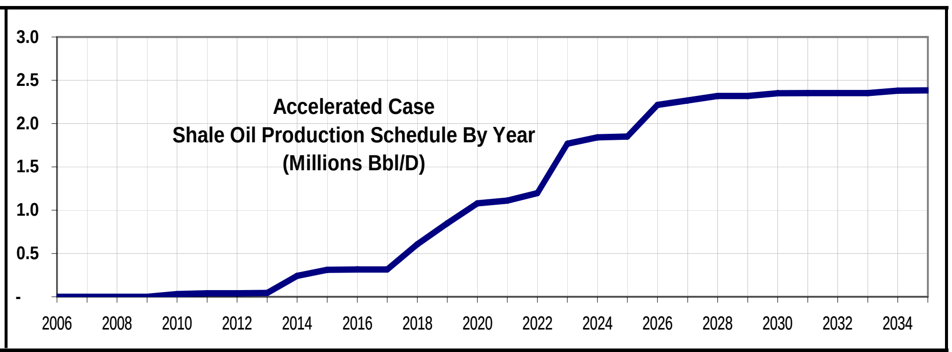
1. Assess public and private markets for shale oil derived fuels and products.
2. Analyze transportation and refinery infrastructure needed to support a growing shale oil industry.
3. Prepare a market plan that helps to resolve distribution and refining bottlenecks. Support cross-cut analysis of all unconventional fuels.

Markets Schedule:

The markets activities and schedule are presented in Figure II-13.

Figure II- 13. Markets Activities and Schedule

Objective: Align fuels production with expected market demand.
Strategy: Understand fuels markets, demand for shale oil, refinery capacities to accept and use shale oil. Provide support to the Department of Defense clean fuels initiative.
Lead: SPR/NPOSR & DoD
Support: National Labs



	2007				2008				2009				2010				2011				Outyear Activities
Markets Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Public/private Markets For Shale Oil	■	■	■	■																	
Shale Oil Transportation & Refining			■	■	■	■															
Markets Plan & Coordination							■	■	■	■	■	■	■	■	■	■	■	■	■	■	Continuing markets planning

Socio-Economic Planning and Impact Mitigation

Objective: Ensure states and communities are ready to support population growth associated with industry development. Mitigate adverse socio-economic impacts.

Strategy: Support development planning, funding, and training to mitigate adverse local impacts and maximize state and local job opportunities and economic growth.

Rationale for Action: Western oil shale is located in a sparsely settled area on the western slope of the Rocky Mountains. The shale deposits are bounded in Colorado by the small towns of Rangely, Meeker, Rifle, and Grand Valley. Glenwood Springs, a larger resort community, is approximately 75 road miles east of the Parachute Creek area; Grand Junction, the area's major trade and services center, is approximately 110 road miles west of the center of potential development. Vernal, Utah is just north of the major Utah oil shale resources. All of the small towns have one common objective; that oil shale development occur in an orderly fashion.

Rapid growth in a relatively small, concentrated area will greatly expand the demand for municipal and human services, such as police and fire protection, medical services, sanitary facilities, educational services, and transportation. In times of rapid growth, revenues fall short of community needs.

For most of the smaller communities, annual operating costs are about equal to annual revenue. Therefore, capital improvement expenditures are largely financed by municipal bond issues that are constrained by statutory bonding limits tied to property values. Rapid population growth makes it extremely difficult for small communities to raise the capital funds needed in a timely manner. Perhaps even more important, it may not even be prudent to bond infrastructure development if there is a prospect that development will fail to be completed.

Rapid development requires detailed analysis, planning and initial preparedness activities that must precede industry development. Funds are not generally available to support such studies, including the preparation of contingency plans.

Under this oil shale sub program plan, the Program will work with affected communities to mitigate the adverse impacts associated with rapid growth.

Socio-Economic Plan:

1. **Support local planning activities**: The Task Force recommends that city-specific planning be undertaken using a minimum and maximum expected development pattern over time. The capital expenditures and the cost of additional services associated with the development profiles represent the minimum and maximum dollars needed to support future growth. The program will provide funding support for these planning efforts as well as in-kind assistance in the form of data, analysis, and coordination support.

2. **Identify funding sources**: Under the 1973 Prototype Oil Shale Leasing Program, Colorado dedicated a part of its lease bonus payments to a fund aimed at community infrastructure. Distributions from the fund from 1975 through 1979 totaled $29.6 million for specific projects including Rangely streets and drainage, Meeker streets and drainage, and Rifle municipal water. Additionally, the Mineral Lease Funds collected by the Federal Government should be evaluated for its potential to serve as an investment bank to augment money that may be raised through a municipal bond. Other options that will be evaluated include allowing industry to fund socio-economic requirements in advance with

corresponding future offsets from taxes or royalty payments.

3. **Vocational Training:** Oil shale industry development will require a variety of skilled trades and professional engineering and management capabilities. Until recently, the pace of oil sands development in Canada has been constrained by shortages of skilled labor, particularly electricians, welders, and steamfitters. Similar shortages could constrain the pace of oil shale development in the west. Vocational training in key skill sets should be made available in and near the affected communities and supported.

<u>Socio-Economic Activities:</u>

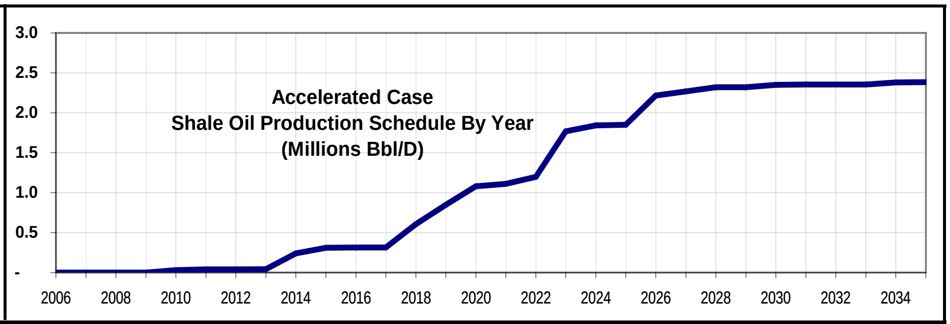
1. Support local planning efforts by direct funding and by providing technical and analytical support. Provide input to cross-cut strategy that considers all unconventional fuels development.
2. Identify funding sources for community development. Recommend legislation as required to implement this funding.
3. Identify labor requirements, potential shortages, and craft a plan for vocational training to support industry development.

<u>Socio-Economic Schedule</u>

The socio-economic activities and schedule are presented in Figure II-14.

Figure II- 14. Socio-economic Activities and Schedule

Objective: Ensure states and communities are ready to support population growth associated with industry development. Protect states and communities from adverse socio-economic impacts.
Strategy: Support development planning, funding, and training to mitigate adverse local impacts and maximize state and local job opportunities and economic growth.
Lead: Affected States & Localities
SPR/NPOSR & DOI



	2007				2008				2009				2010				2011				Outyear Activities
Socio-Economic Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Local Develop. Plans & Coordination																					
Local Vocational Training Plan																					
Fund Community Activities																					Continue community activities

TAR SANDS
SUBPROGRAM PLAN

TAR SANDS SUBPROGRAM PLAN

GOALS AND OBJECTIVES

The program goal is to stimulate and assist private sector development of prospective tar sand resources in the United States in a manner that engenders strong public support. The first development milestones are to establish 2 or 3 small, economically viable ventures producing bitumen or asphalt followed by several larger integrated plants manufacturing syncrude. Technologies developed for 1st generation production will be replicated at other deposits. The production objective is 350 MBbl/d by 2035. It is expected that at least six deposits could be in production within this timeframe.

DEVELOPMENT SCHEDULE

Current interest in U.S. tar sands is quite high. This is due to the continuing success in Alberta, Canada and the clear need for development of unconventional resources in the United States. However, technologies applicable to water-wet, unconsolidated Athabasca tar sands are not directly adaptable to oil-wet, consolidated U.S. tar sands. Further, U.S. tar sands are relatively discontinuous, that is, grade is highly variable and unpredictable, even over short distances. Given the requirement for new technologies and discontinuous nature of the U.S. deposits, achieving the production goals will require proactive measures in a number of technological, fiscal, and institutional areas.

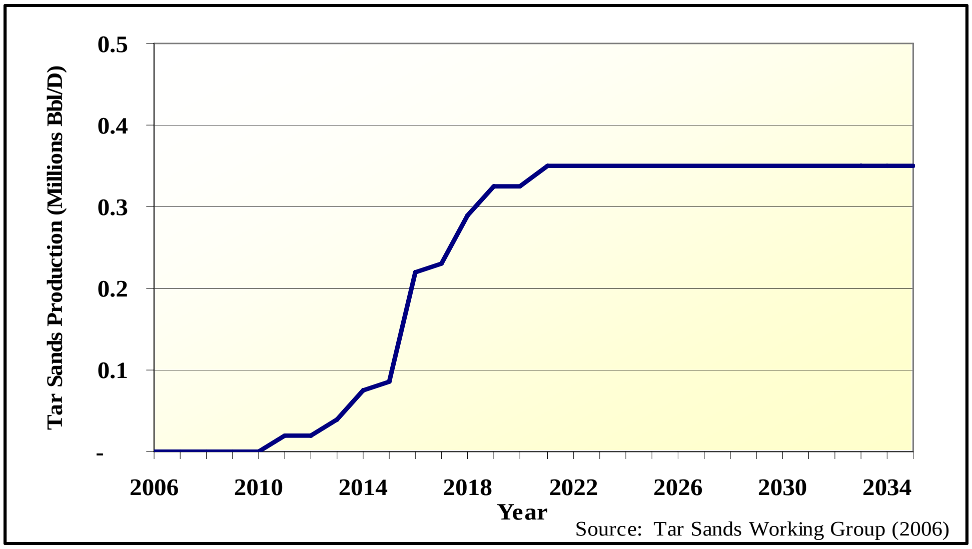
Achieving the production goals requires that:

- Resource is accessible through leasing regulations on terms that are commercially acceptable.
- Resource is sufficiently characterized by reservoir and bitumen properties so logical developments can be delineated.
- Efficient and reliable technologies are demonstrated for resource characteristics (i.e. the treatment of consolidated ore).
- Products are matched to location and volume of demand in the market region.
- A fiscal regime is established that maximizes the value of an investment.
- Land use plans and regulations are favorable for permitting development.
- Local community support is established.

Of the numerous U.S. deposits, there are less than a dozen that are candidates for early development under the oil price projected by the AEO 2006. The development scenario envisions 5 projects in Utah, 2 in California and 1 in Kentucky. There may be additional projects, and not all of the projects envisioned will necessarily come to fruition.

The production schedule is shown in Figure II-15. The strong growth point in the 2015-16 timeframe comes from the advent of the first large integrated plant (in Utah), and new production (in California). U.S. tar sands may encounter resource limitations under foreseeable price scenarios. If it is assumed that economic conditions do not change dramatically over the next 30 years, then only the richest and most accessible deposits will be candidates for development. Given these conditions, a limitation of about 350 MBbl/d is seen in the production graph.

Figure II- 15. Tar Sand Production Schedule (Accelerated Case)



ECONOMIC BENEFITS

The development of a tar sands industry provides potential public benefits. The Federal treasury, state and local governments, and the overall domestic economy will benefit from the direct contributions of a domestic tar sands industry and from the additional economic activity and growth that will result from industry development. Direct benefits can be measured in terms of:

- direct Federal revenues (from Federal taxes and the Federal share of royalties),
- direct state and local revenues (from state and local taxes plus the state share of federal royalties),
- the value of avoided oil imports,
- employment, and
- contribution to gross domestic product (GDP).

The economic incentives put in place will determine the volume of tar sands that is produced. Three cases were used for this program plan to evaluate the effect of economic incentives on tar sand production and the accompanying volume of oil produced:

4. Base Case assumes no tar sands production.
5. Measured Case assumes AEO 2006 reference prices plus a $5/Bbl production tax credit
6. Accelerated Case assumes AEO 2006 reference prices, a $5/Bbl production tax credit, and cost-shared demonstration projects undertaken to reduce the technical risks associated with the development of a new industry.

All analyses are based on the National Strategic Unconventional Resource Model (NSURM)[12] developed specifically for the Task Force by the DOE Office of Petroleum Reserves. The results are not intended to be a forecast of what will occur; rather, they represent estimates of potential benefits under the economic and technological assumptions of each case.

Federal and State Revenues

According to the results of the NSURM, with the incentives introduced in the accelerated case, Federal revenues reach $2.6 billion per year by the end of the 30 year period of analysis. Direct state revenues generated in the accelerated case reach $1.0 billion by 2035.

Total public sector revenues (the sum of direct Federal and state revenues) are shown in Figure II-16. Public sector revenues reach $3.6 billion per year for the accelerated case by 2035 with cumulative public sector revenue of $49 billion.

Figure II- 16. Annual Total Direct Public Sector Revenues ($ Billion)

Case	2015	2025	2035
Base	0.0	0.0	0.0
Measured	0.0	2.2	2.7
Accelerated	0.4	2.8	3.6

Value of Imports Avoided

The accelerated case would save the United States $11.1 billion per year by 2035 that would have otherwise been spent on imports. Figure II-17 displays the value of imports avoided for the three cases. Cumulative imports avoided through 2035 total $178 billion for the accelerated case.

Figure II- 17. Annual Value of Imports Avoided ($ Billion)

Case	2015	2025	2035
Base	0.0	0.0	0.0
Measured	1.5	7.1	6.9
Accelerated	2.2	9.8	11.1

Employment

Tar sands industry development will result in the addition of thousands of new, high-value, long-term jobs in the construction, manufacturing, mining, production, and refining sectors of the domestic economy. The NSURM model estimates direct petroleum sector employment based on industry expenditures. The model also approximates the total number of jobs that will be created in the petroleum sector.

Not all of the direct employment shown will be new jobs to the economy. Some will be filled by workers shifting from one industry sector to another. The jobs will not all be in the states where tar sands development sites are located. Other states that design and/or manufacture trucks, engines, steel, mining equipment, pumps, tubular goods, process controls, and other elements of the physical complex will also share in the jobs creation.

As shown in figure II-18, accelerated tar sands development will create nearly 14,000 new jobs by 2035.

Figure II- 18. Annual Total Petroleum Sector Employment - Direct & Indirect (K Labor Years)

Case	2015	2025	2035
Base	0.0	0.0	0.0
Measured	2.9	7.2	5.2
Accelerated	5.8	14.0	14.0

Contribution to GDP

The direct contribution to the economy, as measured by the Gross Domestic Product (GDP), is significant. By 2035, the annual direct contribution is estimated at $10.8 billion for the accelerated case (Figure II-19).

The cumulative contribution to the GDP for the accelerated case totals $180 billion through the year 2035.

Figure II- 19. Annual Direct Contribution to GDP

Case	2015	2025	2035
Base	0.0	0.0	0.0
Measured	1.7	7.6	7.0
Accelerated	2.4	10.1	10.8

RESOURCE-SPECIFIC CONSIDERATIONS AND STRATEGIES

Tar sands contain bitumen, an oil of greater than 10,000 cP viscosity at reservoir conditions. Viscosity, rather than gravity, distinguishes tar sands from extra heavy oils, and it is this high viscosity that may require some deposits to be mined to be recovered. The size of the deposit will largely determine the size of the plant supported. The U.S. tar sands resource in place is estimated to be 60 to 80 billion barrels of oil, in-place.

U.S. tar sands tend to be lean and the mineral matter tends to be consolidated (sand grains are cemented together with minerals). While lessons may be learned from the experience in Alberta, modifications in those technologies may be necessary to cost-effectively produce synthetic oil from U.S. tar sands. Development and demonstration of technology applicable to U.S. tar sands may be necessary at the pre-commercial or pilot stage before the production potential can be fully evaluated. Collaboration with Alberta interests will greatly facilitate this process.

MAJOR PROGRAM ELEMENTS

The major program elements necessary to accelerate the tar sands industry are identified and presented in this plan and include:

- Resource characterization and access,
- Technology advancement and demonstration,
- Development economics and investment stimulation,
- Environmental protection,
- Regulatory and permitting,
- Infrastructure, and
- Socio-economic planning and mitigation.

For each of these program elements, the objective, strategy, rationale for action, activity plan, and schedule are discussed.

Resource Characterization and Access

<u>Objective:</u> To provide access to all prospective resources. To support the characterization of resources by process-meaningful data, including grade, mineralogy, and physical and chemical properties of mineral matter and organic matter.

<u>Strategy:</u> Expand the working group to include technical representatives from California and Kentucky, and expand representation from Utah. Support the BLM in completing its PEIS and commercial leasing regulations. Engage in resource characterization and screening focusing attention on early candidates for development.

<u>Rationale for Action:</u> Tar sands are highly variable in grade in both the vertical and lateral directions. Of the bitumen has flowed along faults, fissures, coarse-grained stream beds or other non-uniformities. In general, geologic field studies are inadequate to characterize the resource for purposes of economic evaluation. A focused effort that includes core drilling and assays is indicated for the most promising fields.

The private sector has little information upon which to determine if it should become involved with tar sand production. Additionally, regulations for leasing are incomplete, making access to the tar sand resource difficult. In Utah only tar sands located in Special Tar Sand Areas (STSAs) are expected to be available for lease. Yet these STSAs generally represent only the shallow, outcropping deposits and do not include deeper deposits that may be amenable to in-situ recovery. Until these issues are resolved, it is unlikely that there will be development close to the potential that the resource offers.

<u>Resource Characterization and Access Action Plan:</u>

Key features of the action plan are the characterization and prioritization of deposits by relevant properties and recommendations for areas of focus for field assessment and lease offerings. A systematic approach should be taken. Existing date should be assembled, perhaps through the University of Utah Heavy Oil Center, and collaboration sought with various State agencies. Funding will be sought for core drilling and assays. This information will be made available to support competitive leasing of resources.

The plan calls for supporting the BLM mandates to offer commercial leases of tar sands on federal lands, which unlike oil shale, which is currently not available on any regulations is available through regulations promulgated in October, 2005. Examine constraints to blocking of logical development units and develop a mitigation strategy for such constraints. Obstacles such as the uncertainty over citizen-proposed wilderness petitions co-located with tar sand resources should be resolved through federal statute.

<u>Resource Characterization and Access Activities:</u>

1. Establish an expanded tar sand working group whose goal will be to survey existing resources, compile available information, and develop screening criteria for their prospective deposits.
2. Recommend field assessment activities in support of the goals of the program; in particular, support geologic survey activities that strengthen the leasing potential of prospective deposits.
3. Recommend means to delineate logical development units and support activities that block these units.

<u>Resource Characterization and Access Schedule:</u>

The resource characterization and access activities and schedule are presented in Figure II-20.

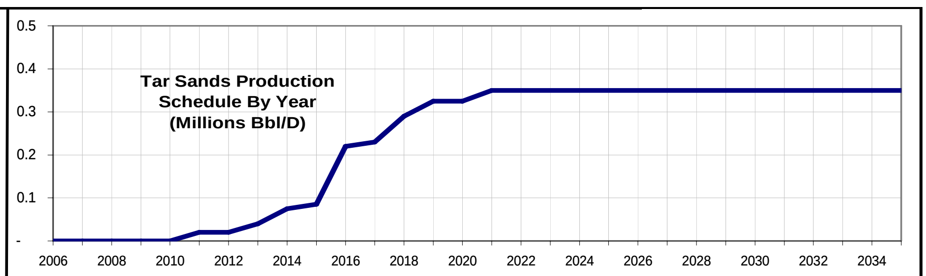
Technology Advancement and Demonstration

<u>Objective</u>: To assure the availability of efficient and reliable technology applicable to all prospective deposits.

<u>Strategy:</u> Promote early field experimentation and development. Pursue at least two in-situ and two surface processing technologies beginning at the next logical step from current

Figure II- 20. Resource Characterization and Access Activities and Schedule

Objective: To provide access to all prospective resources. To support characterization of resources by process-meaningful data.
Strategy: Establish a tar sand working group to make specific recommentaions. Seek federal and state funding for characterization work
Lead: BLM and State land managers on access. USGS and State geologic surveys on characterization and mapping.
Support: Universities, small business



	2007				2008				2009				2010				2011				Outyear Activites
Resource Access Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Form expanded working group	■																				
Screen deposits and recommend field assessment activities			■																		
Delineate LDUs in sufficient detail to support leasing on public lands						■															
Perform Field assessments (optional)							■														
Complete PEIS		■																			
Complete Land Ownership Survey		■																			
Complete Commercial Leasing Regs				■																	
Segregate Combined Hydrocarbon Leases					■																
Offer Commercial Leases						■															
Trade Lands for Facilitation of LDUs and Community Development						■															
Finalize Wilderness determination							■														

development. Provide cost-sharing for field pilot plants and demonstrations of these technologies. Sponsor supporting research.

Rationale for Action: Technologies developed in Canada, while highly instructive, are not directly applicable to U.S. tar sands. Some adaptations may be needed, and for highly consolidated ores, new technology is necessary. U.S. resources are discontinuous (pay zones are interspersed with lean and barren zones) and highly variable in grade within pay zones.

High concentrations of bitumen, or the presence of water, such as is found in the Athabasca deposits, prevent the cementaion of sand grains. However, for those resources that exhibit consolidated ore, new technology may need to be deployed. Where possible wat4er extraction should be employed as the proven, low-cost option. In general, unconsolidated US (Utah) ores are low in fine clay, and there will not be the need for massive tailing ponds as there are in Alberta. But thermal or solvent recovery technologies may be needed for the majority of ores, which are consolidated. To assure an adequate technology base, several technology approaches must be pursued, each selected to be developed on the most promising of sites (Table II-1).

Technology Development Plan: Institute a matrix approach based on the Lukens-Bunger diagram similar to that employed for the oil shale technology development case. With tar sands, production of asphalt of bitumen can be profitably carried out at a smaller scale and in a shorter period of time than the syncrude case. Nevertheless, the milestone objectives to be achieved at each stage in development are substantially the same as for the syncrude case. and resource characteristics in order to assure efficient, reliable, and permitable technology that enables the accelerated development case.

Table II- 1. Technology Readiness Development Matrix (X –Denotes Current Status)

Recovery Approach	Bench	Pilot	Field Semi-works	Demo
Mining and Surface				
Water extraction for unconsolidated ore				
Water extraction for consolidated ore	X	2008	2010	2012
Thermal recovery		X	2009	2012
In-situ				
Steam				
Fire-flood		X	2009	2012
Product Development	X	X	2008	2011

Technology Activities:

1. Funding recommendations – Release Broad Agency Announcement (BAA) early (even before appropriations) to gauge interest and get private sector engaged.
2. University research for basic and bench scale studies (foster cooperation with the private sector; SBIR, STTR + other arrangements).
3. 66 % federal cost shared field pilot plants; two plants in first year, and two additional plants in second year.
4. 33% federal cost shared semi-works and demonstration plants starting in FY09.
5. Consider adding and administrating supplemental funds patterned after the phased SBIR program specifically for the purpose of promoting development of novel ideas in both recovery and product development technology.

Technology Schedule:

The technology advancement and demonstration activities and schedule are presented in Figure II-21.

Tar Sands Development Economics and Investment Stimulation

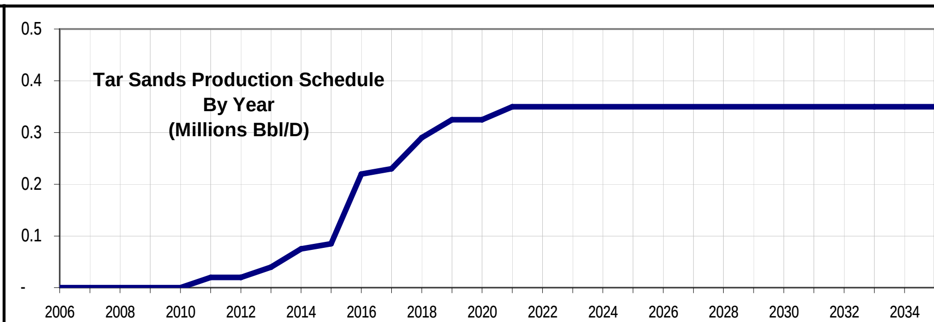
Objective: Create an investment climate favorable for first-generation development in both surface and in-situ technologies.

Strategy: Through dialog with the private sector, identify, assess and propose a suite of tax and royalty treatments that have the effect of early investment payback, cushions against petroleum price declines, and that overcome the first-generation risk hurdles. Establish an expected production schedule. Monitor progress toward the expectations.

Rationale for Action: Fiscal hurdles for initiating a new tar sand industry are significant. At the very least, the U.S. must approximate the fiscal regime of Alberta, just to equalize the investment attractiveness. But in addition the U.S. may need to cost-share demonstration projects that are needed to provide assurances of technology efficiency and reliability when processing ores of variable quality that exhibit differing degrees of consolidation. Scale of operations, product slate, proximity to markets and transportation infrastructure are all important considerations for assessing economics and investment risks.

Figure II- 21. Technology Advancement and Demonstration Activities and Schedule

Objective: To assure that efficient and reliable technology is available for all accessible, rich and prospective deposits.
Strategy: Provide cost-sharing for specific resource development targets. Sponsor supporting research.
Lead: DOE
Support: Small business and universities



	2007				2008				2009				2010				2011				Outyear Activities
Technology Advancement Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
In-situ																					
SAGD																					
Field Pilot							■														
Demonstration															■						
Commercial																				■	
THAI																					
Field Pilot							■														
Demonstration															■						
Commercial																					Commercial scale in 2012
Mining and Surface Processing																					
Water Extraction																					
Unconsolidated ores				■				■													
Consolidated ores						■					■										
Commercial															■						
Thermal						■					■										
Commercial																		■			
Exploratory and Support Research Univ and SBIR model	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	

Development Economics Plan: Establish a suite of risk-reduction measures including:

- R&D investment tax credits, important to stimulating high risk field demonstration.
- Accelerated depreciation to provide offset against tax liabilities in the year incurred.
- Graduated royalty rates minimizing front end cost, not to be deducted from state and local share of mineral lease royalties.
- Sliding scale production tax credits, escalating as oil prices fall below $50/bbl.
- Cost-share field pilots and demonstration to reduce risk and accelerate investment.
- Integrate production schedule with production dynamics for other emerging unconventional fuels projects.
- Establish government corporation to oversee stimulation of industry (included in other unconventional fuels initiatives).

To have the desired effect, note that all actions need to be completed in the next legislative cycle. Delays in completing this legislation will delay development a commensurate amount of time.

Development Economics Activities:

1. Cost shared development of technologies.
2. Support legislative actions that will create a positive environment for the development of a tar sands industry.

Development Economics Schedule:

The development economics activities and schedule are presented in Figure II-22.

Environmental Protection

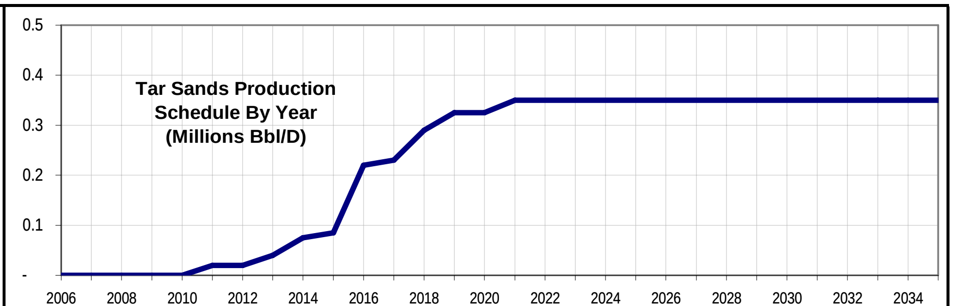
Objective: Enable industry development through support of best available technology development that achieves permitting standards for air, water, and reclamation.

Strategy: Incorporate emissions and discharge goals in technology development. Conduct reclamation research. Coordinate with larger programs for carbon utilization activities.

Rationale for Action: Congress, under the Energy Policy Act of 2005, directed the Department of Interior (DOI) to prepare a Programmatic Environmental Impact Statement (PEIS) for commercial leasing of oil shale and tar sands. This impact statement is currently being prepared. It will analyze

Figure II- 22. Development Economics and Investment Stimulation Activities and Schedule

Objective: Create an investment climate favorable for first-generation development in both surface and in-situ technologies.
Strategy: Legislate a suite of tax and royalty treatments that have the effect of early investment payback, cushions against petroleum price declines, and that overcome the first generation risk hurdles.
Lead: NPOSR/SPR
Support: US treasury/Affected States



Development Economics Activities	2007				2008				2009				2010				2011				Outyear Activities
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Cost shared development of technologies																					Continue Cost Shared Dev.
Establish R & D investment Tax Credit																					
Establish accelerated depreciation schedule																					
Establish Production Tax Credit																					
Establish Graduated royalty rate																					

and document the environmental, social, and economic issues associated with alternative development approaches.

The 2005 Congressional directive represents the first steps toward leasing of oil shale lands since the DOI 1973 Prototype Oil Shale Leasing Program. Environmental issues identified and studied at that time included the impacts of development on the land, on water resources, on air quality, on fish and wildlife habitat, on grazing and agricultural activities, and on recreation and aesthetic values. Because no commercial development had ever taken place to verify the extent of the environmental impacts, the DOI required each lease holder to prepare a Detailed a Programmatic Environmental Impact Statement for Tar Sands. The DOI utilizes proven processes to analyze and to control mineral development on public lands, including tar sands. Public comments on the current effort to develop an oil shale and tar sands PEIS have already been received and will be incorporated into the analysis. A draft PEIS is scheduled for the Spring of 2007, the Final PEIS in the Fall of 2007, and the Record of Decision in Spring 2008.

Under this plan, the Task Force will support the DOI leasing efforts with environmental research targeted to mitigate regional issues associated with water availability, air and water quality and land reclamation.

Environmental Plan: **Support preparation of the Programmatic Environmental Impact Statement (PEIS) for commercial leasing of oil shale and tar sands.** As a part of this support, the Task Force recommends that extant environmental data collected under Interior's prototype oil shale leasing program, as well as oil and gas activities in the tar sand areas be analyzed and the results used to help develop research needed to mitigate adverse environmental impacts.

Develop an Environmental Management Plan. Consistent with the findings of the PEIS and other research, an environmental management plan should be developed that considers the impacts of tar sand development on an industry-wide basis, identifies effective management strategies for industry and government, and defines approaches for monitoring, analysis, and mitigation of environmental concerns.

Craft a carbon management plan to address CO_2 emissions. Carbon dioxide can be captured, but current amine-absorption technology is both energy intensive and costly. Capital expenditures and operating costs for CO_2 capture will depend on the fuel and technology of the heat source and concentration of carbon dioxide in the exhaust stream. The carbon dioxide must be treated for transport to beneficial uses such as improved oil or gas recovery or shipment via pipeline to locations for sequestration. For purposes of this program plan, and in view of the fact that no broad scale regulations are contemplated, the focus will be on the incremental increase in CO_2 production compared to an equivalent amount of conventional petroleum (see Carbon Management Section in cross-cutting issues for examples of how this will be treated).

Craft and evaluate strategies for water resource management. Water use and water quality are of regional concerns in areas of prospective tar sand development. The Task Force recommends that technology developments and environmental reclamation methods focus on minimizing the net requirements for water, on a per unit production basis.

Environmental Activities:

Complete the PEIS process, including a record of decision.

Develop Oil Shale Environmental Management Plan for industry-wide monitoring and mitigation of impacts. Conduct research in air, water, and reclamation.

Evaluate available environmental data to help focus research and support activities.

Define and implement a Tar Sand Environmental R&D plan to support research and technology development focused on mitigation of environmental impacts associated with tar sand development. Consult with Fish and Wildlife Service over impacts to wildlife. Incorporate conservation elements in permit applications.

Calculate the incremental production of CO_2 and devise a plan for capture, concentration and utilization in a manner that can be supported by customary (non-regulated) economics.

Prepare a water resource conservation plan.

Environmental Schedule:

The environmental activities and schedule are presented in Figure II-23.

Regulatory and Permitting

Objective: To add certainty to the timelines for permit review and approval, consistent with public input requirements.

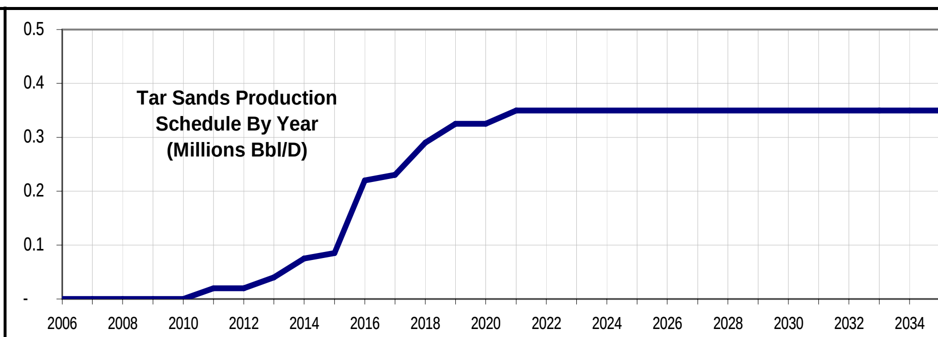
Strategy: Review legislative and regulatory environment; coordinate with streamlining activities in States; legislatively resolve areas of uncertainty. For each State consolidate management of all permitting activities in one state and one federal agency.

Rationale for Action: Uncertainty over the standards and timelines needed for permitting is arguably the greatest deterrent to private investment. Investment funds won't even consider financing a grass roots venture unless the opportunity for profit is so obvious that it outweighs the possible costs from delays. Adding certainty to the regulatory process would be a major step in attracting private development and investment funds.

Regulatory/Permitting Plan: Identify the decision points in the permitting process and perform a risk assessment on each decision point. Identify legislative, regulatory and administrative means of mitigating potential risk. For example, some tar sand areas fall within citizen-advocated wilderness areas, making these deposits potentially off-limits to development. Under current practices the BLM is obligated to retain wilderness values in wilderness study areas (WSAs). Recommend that Congress make a final determination on wilderness and release all other areas from further consideration.

Figure II- 23. Environmental Activities and Schedule

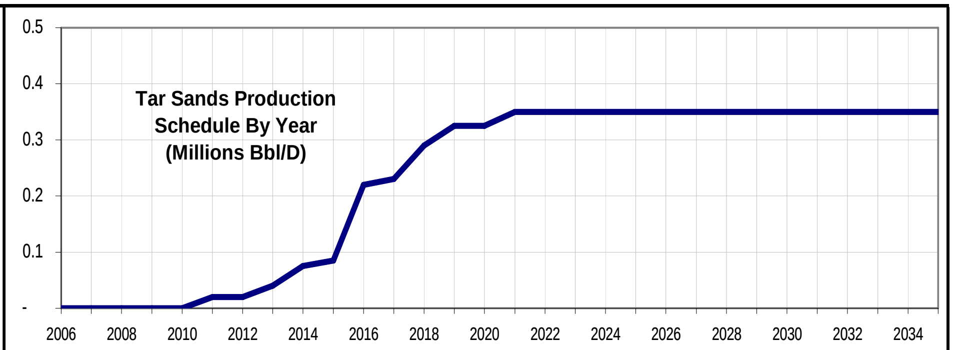
Objective: Enable best available technology development that meets acceptable standards for air, water and reclamation.
Strategy: Incorporate emissions and discharge goals in technology development. Conduct reclamation research. Rely on other programs for CO2 strategy.
Lead: NPOSR/Batelle labs
Support: Universities



Environmental Protection Activities	2007				2008				2009				2010				2011				Outyear Activities
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Support completion of PEIS budget		■																			
Coordinate BACT technology with recovery technology development	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
Conduct supporting research in air, water, and reclamation					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Consult with Fish and Wildlife Service on Potenial Impacts to Wildlife								■	■	■	■	■	■	■	■	■	■	■	■	■	Continue Evaluating Impacts

Figure II- 24. Regulatory and Permitting Activities and Schedule

Objective: Establish an application and review process that certainty in decision time-lines
Strategy: Consolidate permits; legislatively resolve wilderness status, limit standing on protests to relevant timeframes in the permitting process; appropriate adequate funds for regulatory staff.
Lead: DOI/States
Support: EPA



Regulatory and Permitting Activities	2007				2008				2009				2010				2011				Outyear Activities
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Coordinate regulatory streamlining activities with state/local governm.																					
Develop legislative remedies for hearing protests in a timely manner																					
Identify and propose final status on wilderness																					

Develop information in field demonstration programs to inform the BACT standards. Modify resource management plans (RMP.

Regulatory/Permitting Activities:

1. Coordinate regulatory procedures and consolidate permitting activities.
2. Develop legislative remedies for hearing protests in a timely fashion.
3. Identify and propose final status on wilderness.

Regulatory/Permitting Schedule:

The regulatory and permitting activities and schedule are presented in Figure II-24.

Infrastructure

Objective: To ensure timely funding and construction of long lead-time public projects. Ensure availability of funds for community infrastructure. Facilitate utility, water, trans-portation, and government infrastructure.

Strategy: Assess requirements with state, local and Federal governments and engage industry.

Rationale for Action: Certain public infrastructure developments must precede private development, or at least be co-developed with the private sector. Planning and implementation of strategies is needed to mitigate timing delays.

Infrastructure Plan: Coordinate among working groups an assessment and cost estimation document. Prepare a strategy for funding justification and timing. Engage industry support, and coordinate with industry-led infrastructure development. Secure funding and develop projects.

Infrastructure Activities:

1. Prepare planning documents for locales
2. Develop funding strategy

Infrastructure Schedule:

The infrastructure activities and schedule are presented in Figure II-25.

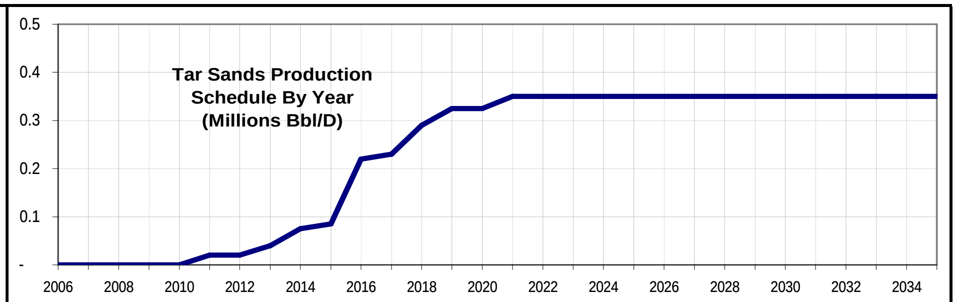
Feedstock and Product Markets Strategy and Plan

Objective: Align product volumes and specifications with local/regional markets.

Strategy: Assess market volumes, product specifications and trends. Coordinate with

Figure II- 25. Infrastructure Activities and Schedule

Objective: Ensure timely funding and construction of long lead-time projects. Ensure availability of funds for community infrastructure
Strategy: Assess requirements and timing. Coordinate between State, Federal and Local governments for Action Plans. Support financing requirements.
Lead: SPR/NPOSR
Support: Affected States and Localities/ DOI



Infrastructure Activities	2007				2008				2009				2010				2011				Outyear Activities
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Prepare planning docs for locales		■																			
Prioritize infrastructure needs by date of initiation and estimate funding needs				■																	
Develop a funding strategy					■																
Implement funding strategy							■														
Initiate Construction of Long-Lead Time infrastructure									■	■	■	■	■	■	■	■	■	■	■	■	Continue Construction

petroleum markets flows. Detail plausible transportation/pipeline needs.

<u>Rationale for Action:</u> Markets must have the ability and willingness to accept products, and this factor will influence timing of a prudent investment. Government needs a framework to assist in decisions pertaining to leasing, amount and focus of R D and D funding, and fiscal regime.

<u>Markets Plan:</u> The Market Plan contemplates a survey of feedstock and product demand trends. Of particular importance for tar sands are markets for bitumen (coker and hydrocracker capacity), asphalt (paving and roofing), syncrude (naphthenic type), and specialty/commodity products such as oils and asphalt additives.

Pricing and price risk will be assessed to ascertain the need for risk mitigation strategies. This survey will be coordinated with production trends and expectations from other sources such as shale oil, coal liquids, heavy oil or conventional oil. From this an integrated pipeline and transportation plan can be completed (jointly with other unconventional production scenarios) and recommendations for indicated government action will be made. Coordination with technology developments will be needed to assure product and marketing initiatives are in line with clean fuel (sulfur, aromatics, etc.) requirements.

<u>Markets Activities:</u>

Product markets will be coordinated with production from other unconventional resources and conventional sources. For each location the available markets for bitumen, syncrude and value-enhancement products need to be assessed. Methods to move products to market will need to be detailed. For projects in oil shale country, design and routing of pipeline systems will need to be conducted in concert with regional developments. Some effort should be made to establish the method by which product price differentials are determined for purposes of providing product-neutral incentives. For example, what system should be used to establish the floor price for bitumen as compared with syncrude.

As a rule petroleum markets are fairly well balanced. That is, there is no pressing need that is currently unmet. New production, therefore, must by some means displace existing supplies, and this is most readily done on the basis of price. The ideal end result is that new production displaces foreign supplies, but regional balances will dictate the feasibility of this. Because the Rocky Mountain region is increasingly supplied by Canadian syncrude, new syncrude supplies will need to compete with established supplies, presumably on the basis of price and quality. In the early years reliability of supplies will be a factor. For bitumen products that cannot be used locally, transport to California markets that have adequate heavy oil processing capabilities is likely to be the economical choice. Planning for product movement is an integral part of the Program Plan.

Markets Schedule:

The markets activities and schedule are presented in Figure II-26.

Socio-Economic Planning and Impact Mitigation

Objective: Obtain permission to practice by assuring mitigation of government costs, adverse impacts to living-standards, and availability of community services.

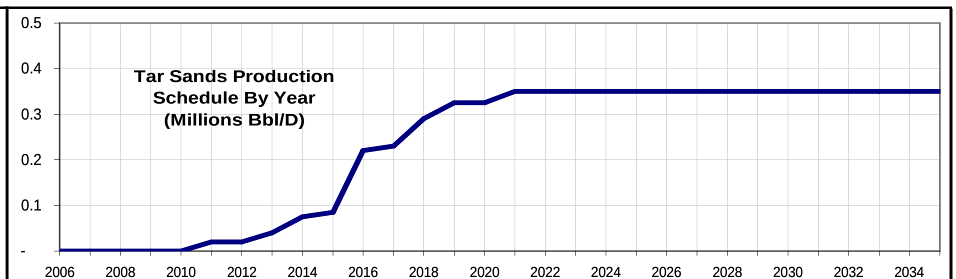
Strategy: Remove obstacles that are preventing local government from receiving revenues from production; establish forums for public input.

Rationale for Action: Tar sand (and for that matter oil shale) developments should occur if the impacts to the local citizenry are unacceptable. Lack of acceptance may be expected if government funds are inadequate for the need, and the public finds itself without goods and services. In the end, socioeconomic impact mitigation is at the heart of public acceptance and should be a top priority of the Program Plan.

Socio-Economic Plan: Support new formulas for getting revenues to local governments. These include PILT amendments, MLA amendments (both distribution and private industry contributions), and formulas for revenue sharing at the local levels (e.g. Mesa and Garfield counties, etc.). A preliminary legislative agenda has been drafted that contains the following:

Figure II- 26. Markets Activities and Schedule

Objective: Align product volumes and specifications with local and regional market needs.
Strategy: Assign assessment task to Tar Sand Working Group. Coordinate with petroleum markets. Detail plausible transportation/pipeline needs
Lead: NPOSR
Support: Contractors



Markets Activities	2007				2008				2009				2010				2011				Outyear Activities
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Survey of product markets and trends		■																			
Assessment of pricing risk and mitigation strategies				■																	
Coordination among other production in the market							■														
Integration of pipeline and transportation plan										■											
Technology Coordination (Clean Fuels)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	

Amend PILT legislation PL 97-258, 31 USC Chpt 69 –

a. Repeal Sec. 6903 (a)(1) Payment Clauses, and renumber.

b. delete the words "reduced (but not below 0) by amounts the unit received in the prior fiscal year under a payment law" at the end of Sec. 6903 (b)(1)(A)

Effect – Repealing this clause will have the effect of releasing Mineral lease funds to the counties. It will also help solve the soon-to-expire exemption for the forest payment issues in the Pacific Northwest.

Fully fund PILT – Current appropriations are only about 2/3 the PILT authorization. Fully funding PILT will assure that no local government is harmed by the proposed repeal of the Payment Laws, which, if not fully funded, will cause some redistribution of current funds.

Effect - By fully funding PILT nobody loses (some may gain more than others).

Amend Mineral Lease Act to provide federal royalty credit for private expenditures toward capital infrastructure investments.

Stipulations may include: a) definition of capital infrastructure as having a useful lifetime of 10 yrs or greater, b) formal approval by cognizant elected officials as being required for a public purpose, c) recoupable as a credit against future royalties on a dollar for dollar basis but not to exceed 50% of royalties due and payable in any given year, d) must be recouped within 12 years from actual investment, e) no alternative federal credits for such investments shall be recognized.

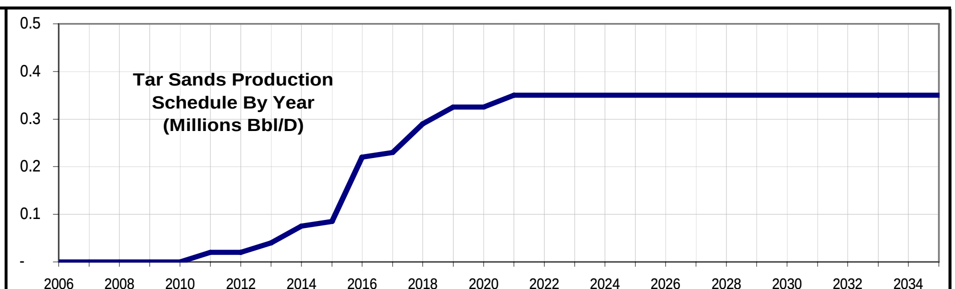
Impact – The use of private money for up-front infrastructure costs reduces the need for appropriated funds, bonding or other public financing needs in the years of expenditures. Public costs for reimbursement of approved expenses are only incurred in the event production occurs, at which time the public receives sufficient new revenues to offset the costs. By engaging the private sector in timely financing of public infrastructure needs, the public/private partnership is strengthened, and the project time-schedule is accelerated.

<u>Socio-Economic Schedule:</u>

The socio-economic activities and schedule are presented in Figure II-27.

Figure II- 27. Socio-Economic Activities and Schedule

Objective: Ensure that adequate government revenues are received by local communities for planning, and pre-production growth expenses and infrastructure development
Strategy: Remove payment laws from PILT. Redirect mineral lease funds to local, impacted communities; provide mechanism for the private sector to participate through pre-payment of federal royalties and taxes.
Lead: NPOSR
Support: States/DOI/MMS



Socio-Economic Activities	2007				2008				2009				2010				2011				Outyear Activities
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Government Revenues - Planning, Infrastructure, and Full Services																					
PILT law modifications																					
MLA modifications																					
State law modifications																					
Major Infrastructure funding																					
Infrastructure Construction																					Continue Constructure

COAL TO LIQUIDS SUBPROGRAM PLAN

COAL TO LIQUIDS SUBPROGRAM PLAN

GOAL AND OBJECTIVE

The goal is for Federal, state and local governments in cooperation with NGO's to stimulate and assist private industry development of a domestic Coal-to-Liquids (CTL) industry in accord with responsible environmental stewardship, on a global, national and regional basis while also protecting states and localities from adverse socio-economic impacts. Achievement of this goal would provide the nation with economic, national security, and environmental benefits.

The objective is to facilitate private sector production of CTL fuels to a degree that they would provide 10% of the nation's transportation fuel requirements (2.6 MMBbl/d) by 2025[13]. Achievement of this objective will require commitments by industry and local, state and federal government organizations.

The Energy Information Administration's 2006 Annual Energy Outlook projects for the first time a developing market for coal liquids that, by 2030 will provide 760 MBbl/d and 1,690 MBbl/d in their reference and high oil price cases, respectively.[14] The National Coal Council[15], in its recent report, suggested that the U.S. should have a goal of achieving 2.6 million Bbl/d of liquids from coal by 2025. The very recent Southern States Energy Board[16] (SSEB) study shows an exceedingly aggressive pathway to eliminate U.S. oil imports by 2030, with CTL providing 5.6 MMBbl/d of fuels.

The September 2006 major oil find by Chevron in the Gulf of Mexico may eventually produce 750 MBbl/d which is based on the high end of the estimated resource of 3 – 15 billion barrels. Initial production is not expected until 2010 followed by a ramp-up of several years before reaching maximum output. This is an important new oil discovery, but it will likely only reduce the degree of continued decline in U.S. crude oil production. The EIA 2006 reference case projects a demand for approximately 23 million Bbl/d by 2015, which is nearly 2.5 million Bbl/d or 10% more than what was consumed in 2004. In the most optimistic scenario whereby other U.S. production is maintained at current levels, the Chevron field would provide 30% of this increased demand and the remainder would need to be provided by imports that will still represent nearly 60% of domestic consumption.

DEVELOPMENT SCHEDULE

The accelerated development by industry can be assisted by the following government (federal and state) actions:

1. Setting an oil floor price to minimize the risk of a prolonged oil price collapse,
2. Providing economic incentives (e.g., production tax credits and loan guarantees) to accelerate industry development actions, and
3. Participating with industry in the early design feasibility studies, engineering design and permitting for first-of-kind projects.

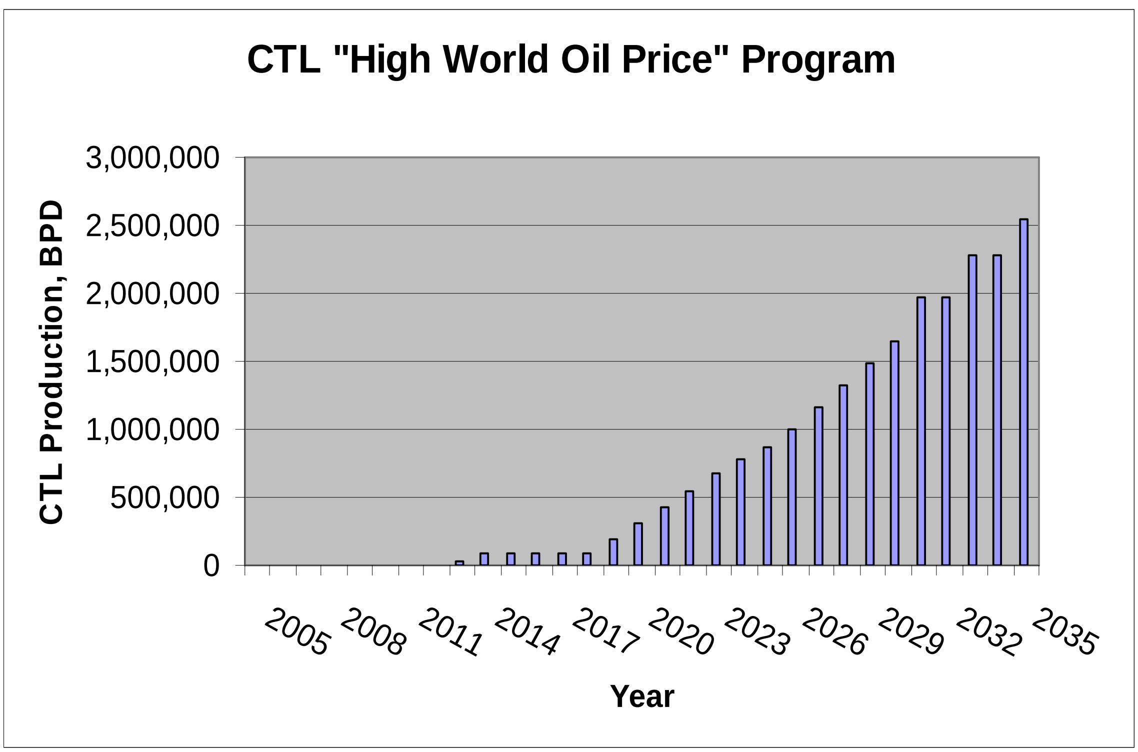
<u>CTL Proposed Ramp-up Discussion</u>

Several organizations have proposed potential Coal to Liquid (CTL) ramp-ups based on their analyses which have been recently published in several major study reports (National Coal

Council, Southern States Energy Board). In addition, the DOE Energy Information Agency (EIA) has included the domestic production of liquids produced from coal in their reference and high world oil cases. The EIA CTL projection for the reference case is 230,000 Bbl/d in 2020 at $45 per barrel* and 760,000 Bbl/d in 2030 at $50 per barrel. For the high world oil case, CTL production is projected to be 290,000 Bbl/d in 2020 at $80 per barrel and 1,690,000 Bbl/d in 2030 at $90 per barrel. These cases are based on the NEMS model. The CTL working group has used two bench marks for preparation of potential CTL ramp-ups. Both are considered to be accelerated and not "business as usual" approaches for the introduction of CTL fuels. The more conservative of the two accelerated CTL production ramp-ups is based on the EIA Annual Energy Outlook 2006 High World Oil Projection Case. This scenario was prepared by the CTL subgroup based on the AEO case which assumes that High World Oil price alone will cause the introduction and ramp-up of CTL. This projected ramp-up, as shown in Figure II-28, is based on the assumed building of the WMPI 5,000 BPD first plant (selected in the DOE's Clean Coal Power Initiative) or one of similar scale, followed by five commercial pioneer plants of 10,000 – 20,000 BPD using a variety of United States coals (Bituminous, sub-bituminous and lignite). In the working group approach, these first plants will have some form of government incentive to facilitate the eventual deployment of regional coal plants of 50,000 – 80,000 BPD that would not require government support.

* All prices per barrel are in $2004

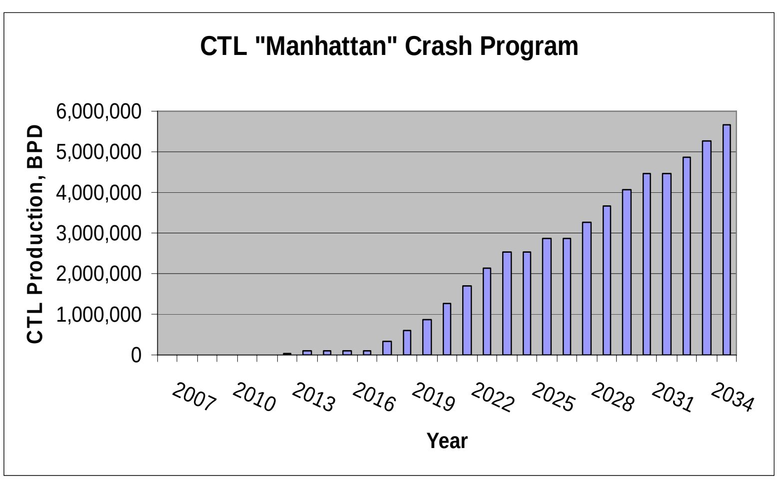
Figure II- 28: CTL Ramp-up based on AEO "High World Oil Price" Scenario



The second ramp-up is based on the recent National Coal Council (NCC) study prepared for the Secretary of Energy in which projection was made for the continued use of coal in an environmentally acceptable manner - including increases in electric production, production of coal based liquid fuels for transportation, production of substitute natural gas and hydrogen. The specific NCC recommendation was for the United States to achieve a production of 2.6 Million Bbl/d of CTL by 2025 (about 10% of 2025 United States petroleum usage). This would require 475 million tons per year of additional coal use. The projection was used by the CTL working group as a bench mark for its ramp-up. The NCC projection, although lower than that projected in the recent Southern States Energy Board – is considered to be a "Manhattan" type crash program that would require not only high world oil prices as identified in the AEO analysis but also significant government incentives as suggested in both the National Coal Council and Southern States Energy Board studies for a series of plants beyond the pioneer plants. The NCC specific key points and recommendations for this Manhattan type ramp-up of CTL production are included in the Appendix to this Action Plan.

The proposed actions are considered the beginning of the process that would need further actions to possibly achieve this aggressive level of CTL production. This projected ramp-up is shown in Figure II-29. As with the previous AEO high world oil price projection, it is based on the assumed building of the WMPI first plant (Clean Coal Power Initiative) or one of similar scale, five commercial pioneer plants of 10,000 – 20,000 BPD using a variety of United States Coal (bituminous, sub-bituminous, and lignite) followed by regional coal plants ranging from 50,000 BPD to eventually 80,000 BPD. In this study the number of plants being initiated during each year (starting in 2014 after the construction and initial operation of the pioneer plants) is assumed to be 5 which is an aggressive approach created by an actual or impending lack of capability to supply the U.S. transportation fuel demand. There is a built-in assumption that readiness issues can be handled. This assumption is being reviewed by an Office of Fossil Energy study. It is assumed that the CTL plants would be regionally dispersed among the major U.S. coal seams – Appalachian, Interior (including Texas lignite), and Western sub-bituminous (including North Dakota/Montana lignite) with each major coal region having one third of the plants.

Figure II- 29: CTL Ramp-up based on National Coal Council Scenario



ECONOMIC BENEFITS

For the purpose of the economic benefits estimation, the NCC and EIA estimates had to be reconciled in order to arrive at a reasonable target for the CTL production goals, based on credible and publicly available information.

The NCC estimates 2.6 MMBbl/d of CTL production by 2025. This is based on target coal production of additional 1300 Mt/yr by 2025. The NCC allocated this additional production for use among five coal conversion technologies including coal-to-liquids (475 Mt/yr), coal-to-gas (340 Mt/yr), coal-to-electricity (375Mt/yr), coal-to-hydrogen (70 Mt/yr), and coal to produce ethanol (40 Mt/yr). If additional coal production is achieved beyond those estimated by the NCC report, then the CTL production goal could indeed be higher. The EIA estimate of 1.69 MMBbl/d of CTL production by 2030 (extrapolated to 2.6 MMBbl/d by 2035) is driven by its high oil price scenario forecast of up to $96/Bbl (stated in 2004 dollars). Although, there is a 10 year gap between the two estimates in achieving the production, both estimates provide an "upper bound" of 2.6 MMBbl/d of CTL production as a goal.

The 2007 EIA reference oil price (low to mid 50's dollar per barrel) projects CTL production of 440 MBbl/d by 2030 (extrapolated to 500 MBbl/d by 2035). This clearly provides a "lower bound" of CTL production goals.

Based on these CTL production goals, an approach was developed to articulate the production ramp up and the corresponding economic benefits for the three development scenarios being considered by the Task Force. A summary of the approach is presented in Table II-2, and a detailed approach is presented in a presentation prepared by the Office of Petroleum Reserves in January of 2007 entitled "*Coal to FT Liquid Economic Analysis – Internal Discussion Draft*"[17].

This approach was implemented using NSURM. The Model was developed specifically for the Task Force by the DOE Office of Petroleum Reserves.

A number of incentive packages were evaluated to meet the production goals of the measured and accelerated development cases. These incentives are based on the recommendations of the NCC and the Southern States Energy Board (SSEB), and they included: accelerated depreciation, expensing of all costs in the year of outlays, extending the $0.50 per gallon alternative fuels

Table II- 2. Approach for Estimated CTL Production Goals

Base Case	Measured Case	Accelerated Case
▪ Use EIA's reference case oil price (2007) ▪ 440 MBbl/d of CTL production by 2030 ▪ 500 MBbl/d of CTL production by 2035 (extrapolated)	▪ Start with Base Case assumptions ▪ Add tax incentives using NSURM model ▪ Select incentives that maximize production while minimizing cost to the Federal treasury	▪ Build on the measured case assumptions ▪ Add engineering design cost share* ▪ Add additional tax incentives ▪ Cap ultimate CTL production at 2.6 MMBbl/d by 2035

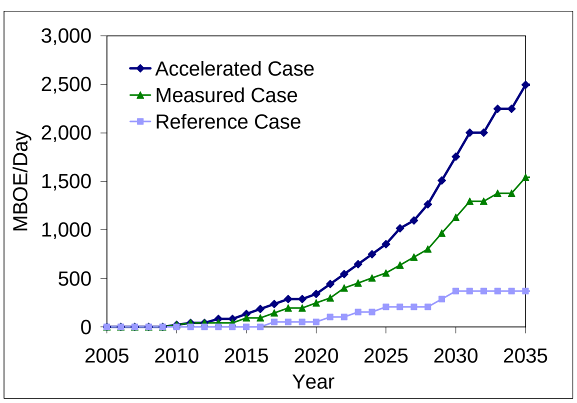
*For 4-6 Pioneer plants of smaller scale, not explicitly modeled

tax credit (additional production tax credits were also analyzed for sensitivity analysis), investment tax credit, floor price and market guarantees, and royalty relief for coal used in the CTL plants. Based on this analysis, an incentives package was selected that maximized the CTL production while minimizing the impact on the Federal treasury. The "*Coal to FT Liquid Economic Analysis – Internal Discussion Draft*"[18] presentation provides detailed evaluation of all incentives considered. The analysis led to the following conclusions:

- **Base Case** - Production goal of 400 to 500 MBbl/d by 2035 based on current law and AEO 2006 oil price track.
- **Measured Case** - Production goal of 1.5 MMBbl/d by 2035 with 20% investment tax credit (limited to project payback).
- **Accelerated Case** - Production goal of 2.5-2.6 MMBbl/d by 2035 with additional production tax credit of $5/Bbl (limited to project payback).*

Figure II-30 shows the production goals for each of the three development cases analyzed.

Figure II- 30. CTL Production Goals for three Scenarios



For each of the development scenarios, a number of benefits were estimated including:

- direct Federal revenues (from Federal taxes and the Federal share of royalties),
- direct state and local revenues (from state and local taxes plus the state share of federal royalties),
- the value of avoided oil imports,
- employment, and
- contribution to GDP.

Federal and State Revenues

According to the NSURM's results, direct Federal revenues generated in the base case would reach $2.8 billion per year by 2035 and $10.8 billion per year in the accelerated case.

Direct state revenues generated by the base case are less than $1 billion per year in 2035. In the accelerated case, state revenues reach $2.1 billion by 2035.

Total public sector revenues (the sum of direct Federal and state revenues) are shown in Figure II-31. Public sector revenues reach $2.8 billion for the base case and $12.9 billion per year for the accelerated case by 2035. Cumulative public sector revenues through 2035 total $28 billion for the base case and $97 billion for the accelerated case.

Figure II- 31. Annual Total Direct Public Sector Revenues ($ Billion)

Case	2015	2025	2035
Base	0.0	1.3	2.8
Measured	0.3	3.1	10.1
Accelerated	0.3	3.4	12.9

Value of Imports Avoided

The base case production of coal liquids would replace imported oil at the order of $10.8 billion per year by 2035. The accelerated case would save the United States $73.1 billion per year by 2035 that would have otherwise been spent on imports.

Figure II-32 displays the value of imports avoided for the three cases. Cumulative imports avoided through 2035 total $117 billion for the base case and $656 billion for the accelerated case.

*More aggressive industry investment could potentially push this level above 3 MMBbl/d[19]

Figure II- 32. Annual Value of Imports Avoided ($ Billion)

Case	2015	2025	2035
Base	0.0	5.9	10.8
Measured	2.5	16.1	45.2
Accelerated	3.5	24.6	73.1

Employment

Coal liquids industry development will result in the addition of thousands of new, high-value, long-term jobs in the construction, manufacturing, mining, production, and refining sectors of the domestic economy. The NSURM model estimates direct petroleum sector employment based on industry expenditures. The model also approximates the total number of jobs that will be created in the petroleum sector.

Not all of the direct employment shown will be new jobs to the economy. Some will be filled by workers shifting from one industry sector to another. The jobs will not all be in the states where coal liquids development sites are located. Other states that design and/or manufacture trucks, engines, steel, mining equipment, pumps, tubular goods, process controls, and other elements of the physical complex will also share in the jobs creation.

Accelerated coal liquids development will create over 90,000 new jobs by 2035. The base case employment is significantly lower as shown in Figure II-33.

Figure II- 33. Annual Total Petroleum Sector Employment - Direct & Indirect (K Labor Years)

Case	2015	2025	2035
Base	3.5	13.0	8.4
Measured	13.2	46.0	52.0
Accelerated	14.8	72.4	90.2

Contribution to GDP

The direct contribution to the economy, as measured by the Gross Domestic Product (GDP), is significant. By 2035, the annual direct contribution is estimated at $69.6 billion for the accelerated case (Figure II-34).

The cumulative contribution to the GDP for the base case totals $111 billion. For the accelerated case, the cumulative direct GDP contribution totals $622 billion through the year 2035.

Figure II- 34. Annual Direct Contribution to GDP ($Billion)

Case	2015	2025	2035
Base	0.0	5.5	10.4
Measured	2.5	15.1	43.1
Accelerated	3.6	23.3	69.6

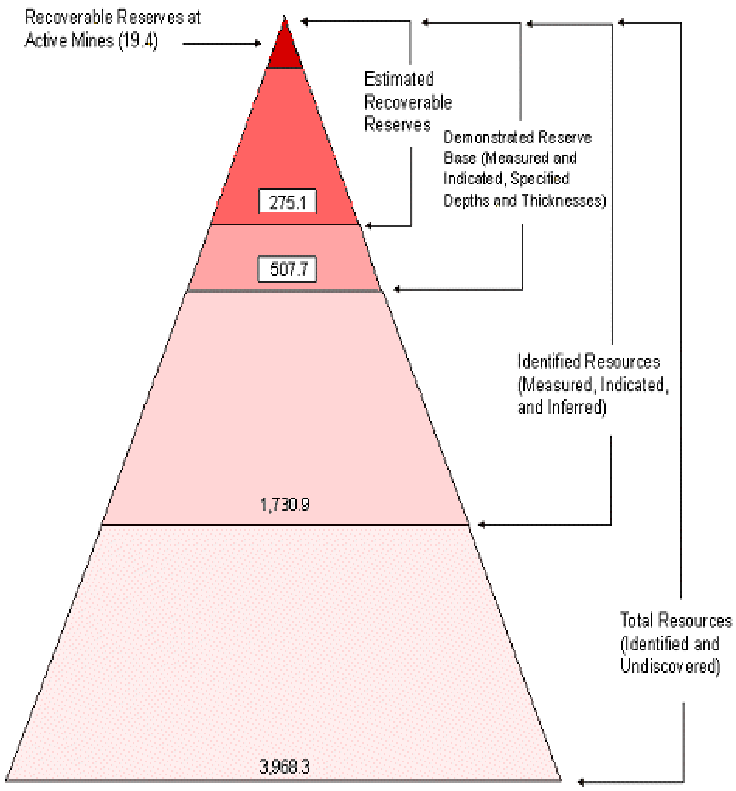
RESOURCE-SPECIFIC CONSIDERATIONS AND STRATEGIES

Coal Resource Base

Coal is the most abundant fossil fuel resource in the U.S. Recoverable coal reserves are estimated (as of January 1, 2005) at 267 billion tons. As coal mining technology improves and additional geological information becomes available, this reserve estimate will grow, since it is based on current mining methods and the *measured* and *indicated* reserves within a *total* U.S. coal resource base estimated at nearly 4 trillion tons (Figure II-35).[20]

Based on current annual production of nearly 1.1 billion short tons, the U.S. has an approximate 250-year coal supply.[21,22] However, this estimate needs to be placed within the context of the projected use of domestic coal in the U.S. and how coal reserves and resources are defined and quantified. To the first point, the EIA projects a steady rise in coal consumption to 1.78 billion short tons by 2030 in its reference economic growth case. The increase is largely due to the need for new coal-fired power generating capacity, projected to increase at 1.5% per year through 2030. To the second point, the EIA estimates the "demonstrated coal reserve base" (DRB) at 508 billion short tons, which would provide an ample cushion to counter any additional increase required for CTL production. The DRB extends the

Figure II- 35. Delineation of U.S. Coal Resources and Reserves



estimated recoverable reserves to include "resources that meet specified minimum physical and chemical criteria related to current mining and production practices."

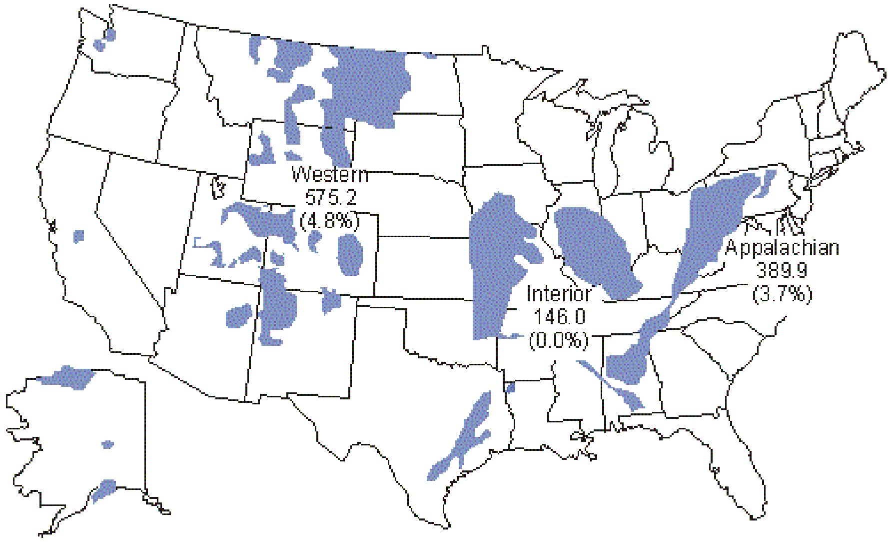
Demonstrated U.S. reserves of bituminous, sub-bituminous, and lignite are 271 billion tons, 185 billion tons, and 44 billion tons, respectively. The coal resources in the U.S., therefore, appear fully able to support strategically significant levels of liquids production from coal. For example, an industry ultimately producing clean coal fuels equivalent of 4 MMBPD would consume roughly 700 million tons of coal per year, depending on the coal quality. A century of liquids production at this level would consume about a quarter of the currently estimated recoverable coal reserves. This should be more than enough time to allow the transition to non-fossil sources of transportation fuels.

Action Recommendation: As identified in the SSEB's recent study, Section 604 of the Energy Policy and Conservation act amendment of 2000 required that the United States Geological Survey develop estimates for oil and gas reserves. The SSEB recommended that a similar survey be conducted for coal because of its importance to the energy future of the United States and the fact that the definitions for resources need to be updated.

Coal Production and Use in the U.S.

Coal resources are broadly distributed throughout the U.S., with coal mines operating in 26 states. Recoverable reserves are located in 33 states, of which the 15 states hold about 96% of the nation's total.[23] Figure II-36 shows that about half the coal is produced in the West, including Alaska, and the other half from the interior and Appalachian regions.

Figure II- 36. Map of Coal Distribution in the U.S. (Current Production in Millions of Short Tons per Year in 2004 and Percentage Increase in Production over Prior Year)



While recent coal production of 1.11 billion tons has been close to all-time highs, over the past 20 years there has been a shift in production from the Midwest and the Appalachian region to the Western region, in particular, to the Powder River Basin in Wyoming and Montana. This geographic shift reflects greater reliance on large surface mining operations, due to the geological characteristics of Western coal deposits and technical advances that have lowered the costs of surface excavation of coal. For new energy plants located east of the Mississippi, the lower cost of western coal may be balanced by the economic advantages in the Interior and Appalachian regions of the U.S. that have an extensive number of mines and interconnected transportation infrastructure.

U.S. coal reserves are categorized by rank, which relates to its age and thermal energy content. The three major coal ranks are bituminous, sub-bituminous and lignite in descending order of thermal energy content. These coals also cover a wide variation in sulfur, moisture and mineral matter content. Anthracite, the highest ranked coal, is not included in this analysis because it represents only 3% of the nation's estimated recoverable coal reserves. Although a niche market may develop for anthracite-fueled CTL plants anthracite coal is not likely to be a significant resource for fueling new power generating and CTL plants.

Nearly all coal produced in the U.S. is used domestically for electric power production.[24] More than one-half the electricity generated in the U.S. comes from coal-fired power plants. Over the next few decades, coal's major role in power production will likely continue, if not increase in magnitude. For example, between 2004 and 2030, the EIA forecasts in its AEO2006 reference case that total electricity generation will grow from 4.0 to 5.9 trillion kilowatt-hours, with coal's share of nationwide power generation growing from 50 percent to 57 percent.

Coal Quality Issues for CTL Production

Coal is a complex substance, with composition and characteristics varying greatly among the various deposits in the U.S. For CTL production, the key variable is coal rank, but even within the same rank, ash content and the consequent variation in properties of the ash as it is transformed during heating can be decisive in process design.

Table II- 3. Regional Coal Characteristics (As-Received Basis)

Region	Reserves, Billion Short Tons	Btu/lb, HHV	Mineral Matter, %	Sulfur, %	Moisture, %
Bituminous Coal Appalachian [a]	19.3[f]	13,404	9.1	2.15	1.7
Bituminous Coal Midwest [b]	38.2	11,000	14.3	4.45	8.0
Sub-bituminous West[c]	21.8	8,426	6.3	0.45	28
Sub-bituminous[d]	2.5	7,800	9.0	0.2	27
Lignite Southwest (Texas)[e]	9.95	7,900	9.0	0.59	30
Lignite North Dakota[f]	6.9	7,800	8.2	0.69	27

a Argonne National Laboratory Premium Coal Sample Bank (Pittsburgh #8), http://www.anl.gov/PCS/
b NETL, "Quality Guidelines for Energy System Studies", 2-24-04 (Illinois #6)
c NETL, "Quality Guidelines for Energy System Studies", 2-24-04 (Wyodak)
d Usibelli Coal Co. web site, http://www.usibelli.com/specs.html
e Wilcox seam, from SNG paper.
f Benson, S.A. Mitigation of Air toxics from Lignite Generation Facilities, Energy & Environmental Research Center, 1995

Table II-3 shows coal ranks, their differing characteristics showing the great diversity of United States coals and need for plants with different coals to develop sufficient CTL plant data. When evaluating sites for CTL plants, the intended coal resource(s) for the plants will require different coal processing requirements to accommodate each plant's technology configurations and ensure equivalent product quality required by the consumer.

MAJOR PROGRAM ELEMENTS

Program elements needed to support private coal-to-liquids commercial development are identified and discussed in this plan. Major program elements are:

- Resource availability
- Technology Advancement and Commercial Assistance
- Coal-to-Liquids Economics and Investment Stimulation
- Environmental protection
- Regulatory and permitting
- Infrastructure
- Socio-economic planning and impact mitigation

For each program element, the objective, strategy, rationale for action, activity plans, and schedule are presented and discussed.

Resource Availability

Objective: Assure there is access to coal resources required to meet future demand.

Strategy: The following items could provide a template for strategy that would be implemented to meet the Nation's coal requirements for electricity and transportation fuels:

- Analyzing public policy, mine siting, and permitting and safety issues to create recommendations for eliminating key infrastructure barriers.
- Updating the coal resource base by applying most current methodology; and

- Preparation of a policy document addressing the status of mining research and a determination as to whether it is sufficient to meet the Nation's needs for increased production and safety while reducing environmental impacts

As identified in the Southern States Energy Board's (SSEB) recent study, Section 604 of the Energy Policy and Conservation act amendment of 2000 required that the United States Geological Survey develop estimates for oil and gas reserves. The SSEB recommended that a similar survey be conducted for coal due to its importance to the energy future of the U.S. and that the definitions for resources need to be updated.

Rationale for Action: Coal is dispersed regionally throughout the U.S. Significant progress has been made in coal mining, both in its productivity and safety. These efforts would need to continue, including the opening of new mines, in order to meet the projected increasing demand for electric power generation and a new industry based on producing coal liquids.

Technology Advancement and Commercial Assistance

Objective: Enable near-term application by industry of viable current commercial technologies.

Strategy: The production of 2.6 MMBPD of liquid fuels from coal by 2035 by industry could be fostered by a two-pronged approach in which the government:

- Facilitates limited early learning commercial experience.
- Establishes the foundation of a strategically significant CTL industry.

Specific actions would include: sponsoring feasibility studies; preliminary and engineering designs; permitting; and providing financial incentives to foster the deployment of early pioneer plants. These plants would provide the basis upon which to improve the efficiency and economics of future, full-scale commercial plants by accelerating the introduction of advanced technologies.

These measures would support the initial steps for the Measured Development Case and the Accelerated Federal Action Case identified in the Task Force on Strategic Unconventional Fuels June 2006 report. To facilitate introduction and integration of these new systems in the U.S., governmental entities including federal, state and municipal organizations would be expected to participate with industry in the preparation of site specific design studies and analyses, and help define the specific financial incentives such as tax credits, floor price guarantees, long-term guaranteed product off-take agreements, and loan guarantees that would reduce the industry's economic risk (see "Coal-to-Liquids Economics and Investment Stimulation" section). The effect of these approaches, alone or in combination, would be to help mitigate the uncertainties associated with building and operating first-of-a-kind CTL plants. The effect would be to make this CTL technology option feasible in the market at an earlier time, and help foster the continuance of the nation's industrial development, technology advancement and creation of new labor markets.

Rationale for Action: The public has concerns regarding energy security, national security, high world oil prices, potential for global petroleum resource depletion, and environmental issues (criteria pollutants and global climate change). These concerns are providing cause to investigate if the public interest will be served by fostering industry to accelerate the entrance of alternative coal-based fuels into the market place.

CTL plants are operating commercially in South Africa. Similar technology could be deployed in the U.S. However, advancements have been made since the 1980s vintage South African plants began operation. To facilitate introduction and integration of these new systems in the U.S., governmental entities including federal and state could participate with industry in the preparation of site specific design studies and analyses, and help define the specific financial incentives such as tax credits, price floor guarantees, guaranteed long-term product off-take agreements, and loan guarantees that would reduce the industry's economic risk. The effect of these approaches, alone or in combination, would be to reduce the uncertainties associated with building and operating first-of-a-kind CTL plants. The effect would be to make this technology option feasible in the market at an earlier time, and help foster the continuance of the nation's industrial development, technology advancement and creation of new labor markets.

Technology Plan: These measures would support the initial steps for the Measured Case and the Accelerated Federal Action Case identified in the Task Force on Strategic Unconventional Fuels June 2006 report.

Facilitating limited early learning commercial experience would reduce economic uncertainties and technical risks surrounding deployment of first-of-a-kind pioneer plants. These "early" plants would: test the reliability of state-of-the-art technologies; provide the operating experience needed to reduce "Nth" plant capital and product costs; and support the formation of an economically viable domestic industry.

There are several actions that are considered important to help achieve a self-sustaining domestic coal fuels industry:

a. Building the internal engineering and scientific capacity to sustain a high-volume industry,
b. Improving the performance and reducing costs of CTL technologies,
c. Performing R&D in key areas that impact the industry's economic and environmental performance, including cost effective carbon capture and storage
d. Creating potential first markets for CTL products, and
e. Assuring the quality of coal-based liquid products through real-world tests.

The following specific actions could be implemented:

1. Facilitate Limited Early Learning Commercial Experience

Co-Fund Site Specific Design Studies

Private sector companies and the federal government (DOE) have conducted research and development since the early 1980s to improve F-T technology. Advanced coal gasification and F-T conversion technologies have been developed to reduce product cost, but have not been demonstrated in an integrated system at sufficient size to confirm the potential economics and production efficiencies. Significant risk will remain until plants integrating the technologies are designed, built, and operated. Design studies would provide private sector partners and the federal and state governments with solid information on economic viability and technical risk. Industry would use this experience to develop the confidence needed by capital markets to secure financing and the government would use the information to guide research and provide an incentive framework targeted at facilitating the deployment of CTL plants.

It is suggested that design studies be performed, for example, for five regionally dispersed plants that, collectively, would use coals that represent the key coal types found in the U.S. This strategy would provide a portfolio of CTL from the important specific coal regions and also create designs for liquid fuels plants that utilize coals having diverse characteristics (e.g., ash, sulfur, moisture, heating value, and metals). The designs would then provide the basis for industry and government decision-making on detailed design of three to five baseline pioneer plants (10,000 to 20,000 BPD) projected to begin production in 2012 to 2015. Government (federal, state) upfront funding for these designs, with significant cost sharing by industry, would encourage serious and capable industrial participants and stakeholders. The government entities would evaluate the need for additional up-front funding for follow-on site-specific engineering designs activity for specific locations to foster the construction of these pioneer plants.

Analyze Incentive Packages Directed at Promoting Early Commercial Experience

There is significant technical and financial risk associated with first-of-a-kind, pioneer CTL plants. Various financial incentives could reduce this risk and meet the aggressive goal of having up to five regional coal-to-liquid plants in operation during the 2012 to 2015 timeframe. To define the optimal package of incentives that reduce technical and financial risk and spur industry interest while minimizing the cost to the federal government, DOE and DOD would jointly sponsor a study of incentives that achieve these goals. This study would review historical experiences with earlier incentives-based programs as well as examine existing incentives from EPACT 2005, and Section 11113 of the surface transportation act (SAFETEA-LU), which amends the IRS code for the Volumetric Excise Tax Credit for Alternative Fuels, providing a $0.50 per gallon credit for F-T liquids produced from coal (terminating on September 30, 2009). Additionally, new incentives – such as loan guarantees, investment tax credits, floor price guarantees and ceilings, product off-take agreements, and other innovative mechanisms – would be evaluated for applicability to these first plants. The study would also investigate regional incentive packages. Upon completion, DOE would report the results of the incentives analysis to the Administration and Congress.

2. Establish the Foundation for a Strategically Significant CTL Industry

Establish and Implement Critical R&D Needs

Significant progress has been made in advancing current technologies that have been developed but not yet demonstrated for large first-of-a-kind, pioneer CTL plants. Additional advances that are being pursued in current DOE programs can further reduce the cost of producing ultra-clean liquid transportation fuels from coal, possibly by 25% or more through novel pathways or even in-situ processing. These programs include: clean coal technology development in: coal gasification, syngas cleanup, carbon capture and storage; and hydrogen via the production of high hydrogen-content liquid carriers. This latter program could be structured to include:

- Computational science to shortcut development time could provide the theoretical basis for subsequent R&D activities, and explore novel "out-of-the-box" processing strategies to guide and accelerate experimental research. The computational work would likely focus on critical chemical and physical aspects of converting coal to premium fuels: the fundamentals of catalyst activity/selectivity; separation of small catalyst particles from the liquid product; impact of the fuel on engine performance and durability; optimum system integration to achieve high process efficiency, minimal pollutant emissions and CO_2 capture; and computational frameworks to enable virtual demonstration of the entire fuel life cycle. These findings could be experimentally verified by laboratory research and modeling, followed by larger-scale bench and pilot-scale testing
- Systems engineering activities aligned and coordinated with the computational and experimental research to evaluate: advanced integrated gasification and F-T

processing concepts and clean-up technology; advanced reactor types to improve the process efficiency when utilizing specific regional coals; novel in-situ reactions/processing; and modeling of the gas-solid-liquid physics of the F-T reactor to help achieve the highest throughput and liquid product quality. Life cycle analyses would also be performed on a "mine-to-wheels" basis to pinpoint those parts of the overall system impacting health, environment, and safety.

- Analyses of advanced coal liquefaction technologies with emphasis on combining direct and indirect liquefaction technologies in a hybrid system to efficiently produce affordable liquid fuels that meet the strictest U.S. environmental requirements and fuel performance specs. This may lead to small scale experimental activity to verify analysis findings.

Department of Defense Strategy for the Characterization, Certification, and Procurement of Liquid Transportation Fuels

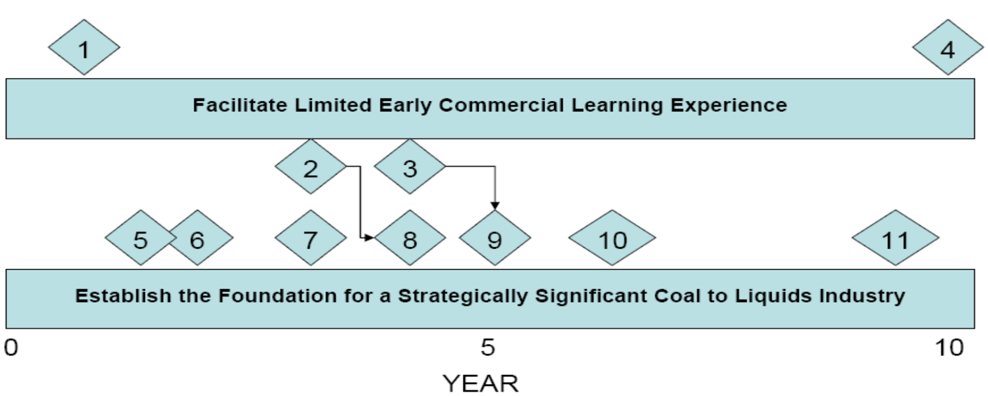
Fuels for DOD applications will require characterization and certification at end-use scale prior to being deployed in DOD legacy and advanced applications – such as high-performance jet aircraft. DOD will require up to 200,000,000 gallons for their fuel characterization efforts.[25] These tests will likely run from 2007 to 2011, with the bulk of the fuel required in the last several years. These fuels must be of specific compositional quality and flash point range, and will require chemical additives developed through a separate R&D activity. This certification effort will provide a significant data base upon which the commercial airlines can utilize to avoid the expenses associated with redundant fuel and engine testing.

DOD is interested in long term prospects for the manufacture and supply of aviation synthetic fuels in increasing quantities, with emphasis on domestic industrial capability and feedstocks.[26] DOD has stated that it prefers to purchase these fuels and additives from private sources. In addition, DOE could provide some small quantities of fuels through its Hydrogen from Coal Program, which has two projects capable of producing F-T fuels as high hydrogen content liquid fuel carriers:

- Syntroleum – Small-scale production of F-T fuel from a simulated coal-derived synthesis gas or from a slip-stream at a currently operating gasifier unit.
- Headwaters/HTI – Small-scale production of F-T fuel from a 10-BPD unit to be built and operated on a coal-derived synthesis gas utilizing different iron catalysts.

Technology Schedule: An example of a federal and state government participation program is presented in figure II-37.

Figure II- 37: Sample Schedule for Potential Governmental Participation



Facilitate Limited Early Commercial Learning Experience

- Year 1 – Initiate support of Treasury Department in implementation of EPACT 2005 Section 1307 (i.e., amendment to Sections 48A and 48B of Internal Revenue Code.)
- Year 3 – Report on analysis of incentives directed at promoting early commercial experience completed.
- Year 4 – Co-funded, site-specific design feasibility studies completed.
- Year 10 – With industry utilizing Section 48A and 48B tax credits or other available incentives, three to five pioneer plants are built and operational.

Establish the Foundation for a Strategically Significant Coal to Liquids Industry

- Year 2 – Provide fuel samples for DOD testing from existing DOE RD&D projects.
- Year 2 – Initiate and implement critical R&D needs for a CTL industry.
- Year 3 – Initiate technical support to DOD for procurement, characterization, and certification of unconventional liquid fuels.
- Year 4 – Based on the incentives analysis report completed in item 2, analyze and select incentives in support of large-scale CTL industry development.
- Year 5 – Based on feasibility studies in item 3, establish industry interest to design/construct pioneer plants.
- Year 6 – Complete assessment of R&D improvements and potential advances at process development unit scale.
- Year 9 – Improved technology available to industry for future plants.

Coal-to-Liquids Economics and Investment Stimulation

Objectives:

- Allow fuels projects to compete favorably with other investment options.
- Stimulate industry investment in fuels projects.
- Minimize risks to public treasuries.
- Assure market(s) for initial coal-to-liquids production.

Strategy: Identify, analyze, and propose a fiscal regime of tax, and pricing structures that will attract private development capital.

Rationale for Action: CTL development is characterized by high capital investment, high operating costs, and long periods of time between expenditure of capital and the realization of production revenues and return on investment. Revenues are uncertain because future market prices for coal-based liquid fuels and byproducts are unknown. Therefore, a key economic barrier to private development is the inability to predict when profitable operations will begin. The economic risk associated with this uncertain outcome is magnified by the unusually large capital exposure, measured in billions of dollars per project, required for development.

Because no grassroots CTL plants have been built since the early 1980s, it is difficult to accurately estimate the costs of liquid fuels produced from new facilities. The Sasol plants came in on budget with a capital cost of about $6 billion. This would equate to approximately $40,000 per daily barrel at a production rate of 150,000 BPD. However, it is not possible to meaningfully compare this data with a new CTL plant built in the U.S. The Sasol plants produce a substantial amount of chemical byproducts, and in many years, revenue from these byproducts has exceeded the revenue from the fuels. Inflation and fluctuating currency exchange rates also complicate comparison; the Sasol plants were built in the early 1980s, so the capital cost of $40,000 per daily barrel in 1980 dollars would be approximately double in 2005 dollars.

To estimate the potential costs for new CTL plants in the U.S., one must resort to conceptual plant simulation analyses. In 1993, Bechtel undertook a conceptual baseline design study of a nominal 50,000 BPD bituminous coal-based F-T plant for the U.S. Department of Energy (DOE). In 1993 dollars, Bechtel estimated the capital cost to be $59,500 per daily barrel.[27] Adjusting for inflation to 2004 dollars, this capital cost estimate becomes about $80,000 per daily barrel. If this cost represents a first-of-a-kind (FOAK) facility, then it can be assumed that, through learning by design, building of pioneer plants, and industry - targeted research to develop advanced technology, this capital cost could be reduced. A rough estimate is that the capital costs of a 50,000 BPD plant will be between $3.5 and $4.5 billion.[28] Overall, smaller, FOAK CTL plants with fuel production in 10,000 to 20,000 BPD range are unlikely to be profitable unless the price of low-sulfur, light crude oil is at least $40 to $55 per barrel depending on the coal used[29]. This price range takes into account the wide range of costs for delivered coal and the band of uncertainty associated with preliminary cost analyses. As noted, FOAK pioneer plants will likely be built with a lower output and thus have higher per barrel capital cost requirements. On the other hand, subsequent, 50,000 BPD plants will benefit from learning-by-doing, and it is not unreasonable to anticipate production costs dropping to below $40 per barrel if the activities proposed are conducted.[30]

To facilitate introduction and integration of FOAK CTL plants in the U.S., governmental entities including federal and state's would be expected to participate with industry to help define the specific financial incentives such as tax credits, floor price guarantees, long-term guaranteed product off-take agreements, and loan guarantees that would reduce the industry's economic risk. The effect of these approaches, alone or in combination, would be to reduce the uncertainties associated with building and operating first-of-a-kind CTL plants.

Implementation of EPACT 2005 Section 1307 – Investment Tax Credits

To facilitate deployment of early pioneer CTL plants, some form of incentive package would be required to address the economic uncertainties and technical risks associated with constructing and operating first-of-a-kind plants. Section 1307 of EPACT 2005 (Public Law 109-058) amended Sections 48A and 48B of the Internal Revenue Code to include incentives that reduce the risk of coal gasification projects. While the focus of the Sections 48A and 48B incentives are related to integrated gasification combined-cycle (IGCC) technology, advanced coal-based generation, and industrial gasification, these incentives are also available for co-production facilities that would produce both electric power and liquid fuels from coal. The Department of Energy, along with the National Energy and Technology Laboratory are currently providing technical support to the Secretary of Treasury regarding implementation of the Sections 48A and 48B incentives. It is possible that one or two pioneer CTL plants would benefit from these current incentives.

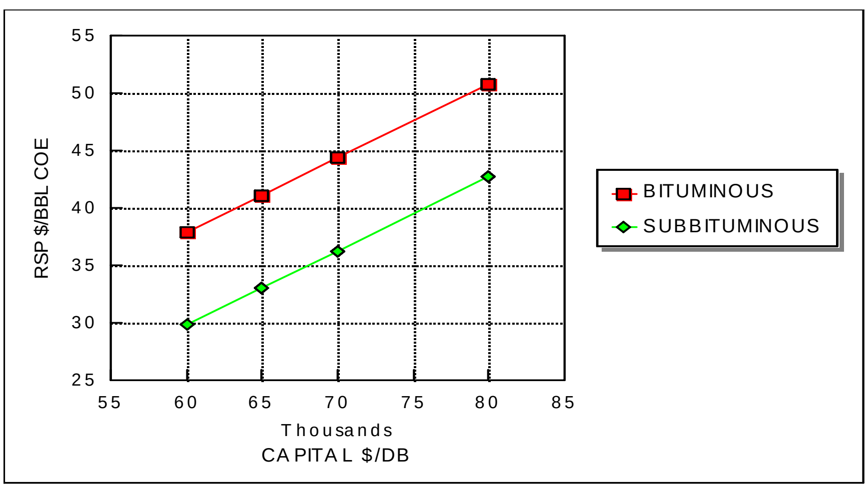
Recently, several Congressional bills have been introduced (HR 5653 and Senate 3325) that, if enacted, would provide significant incentives for Fischer-Tropsch plants of 10,000 to 20,000 BPD production capacity or more. These bills cover the potential for additional loan guarantees, tax credits for capital expenditures, and treating capital expenditures as expenses and excise tax reductions. If enacted, these and other potential incentives will need to be evaluated by the Department of Treasury.

Implementation of EPACT 2005 Section 1703 – Loan Guarantees

Under Title XVII of the Energy Policy Act of 2005 (Section 1703) Congress provided for loan guarantees for Integrated Gasification Combined Cycles and gasification for industrial applications. Under this section, loan guarantees could be provided for IGCC power plants, sequestration-ready, with assured revenue streams. This section includes western coal gasification, IGCC in taconite-producing regions (Minnesota), waste coal to FT fuels, coal to fuels using Western coal, industrial gasification (syngas), and pet coke gasification. This may include repowering of existing facilities. Sec 1703(c)(1)D identifies that facilities that generate H2-rich and CO-rich product streams from gasifying coal or coal waste and use those streams to produce Fischer-Tropsch liquids may be included. Based on this title of EPACT 2005, the Department of Energy has set up a loan guarantee office to manage this activity and to set guides for the granting of these loan guarantees. The legislation required DOE to ensure that applicants for the loans propose projects that will (i) curb emissions (air pollution, GHGs), (ii) propose innovative technology (not in wide commercial use) and (iii) have "Reasonable prospects of repayment". The U.S. Department of Energy has organized the office and is preparing guides for submissions of loans under a competitive process.

Furthermore, Figure II-38 plots the estimated economics of CTL plants for bituminous and sub-bituminous coals[31]. The lines show the variation of the required selling price (RSP) of diesel fuel produced from CTL plants using bituminous and sub-bituminous coal as a function of the capital costs.

Figure II- 38. Economic Summary for CTL Plants



Assumptions:

1. Bituminous coal is priced at $30 per ton; sub-bituminous at $10 per ton
2. The capital charge factor is 12 percent. (Capital charge is the percent of capital cost that must be recovered each year)
3. The capacity factor of the plants is assumed to be 90 percent. This factor refers to the actual production over a specified time period divided by plant design production.
4. F-T diesel has a differential value that is $9 per barrel over crude oil based on the historical differential value between WTI and CARB diesel for the last three years.
5. The RSP is given in terms of the dollars per barrel on a crude oil equivalent basis.

A 32,000 Bbl/d plant using bituminous coal would have capital costs in the range of $81,000 to $92,000 per barrel of daily capacity, depending on coal type and financial assumptions. Per barrel capital costs will decrease as plant capacity increases. For the purpose of this analysis, a capital cost range of $60,000 to $80,000 per daily barrel was chosen, based on prior conceptual study results for a modern CTL plant with a capacity of between 30,000 and 60,000 Bbl/d capacity.

Referring to Figure II-38, if the capital cost of a first-of-a-kind CTL plant is $80,000 per daily barrel, the RSP of the diesel fuel on a crude oil equivalent basis would be $51 per barrel and $43 per barrel for bituminous and sub-bituminous coals, respectively (this is equivalent $46 per barrel and $40 per barrel for bituminous and sub-bituminous coals if we utilize the crack spread assumed in the Southern States Energy Report). Clearly, more detailed design studies must be initiated to more accurately define costs for site-specific locations and particular coals.

The diesel fraction, representing 70 to 80% of the CTL product slate, would have a cetane number greater than 70, which improves combustion efficiency. Because of the high quality of these liquids, no additional refinery upgrading is needed to produce ultra-clean diesel and jet fuels. Naphtha, representing the other 20 to 30%, makes an excellent cracker feed for olefins production or other chemicals and may be a valuable fuel for advanced engines. Also, it could serve as an excellent material for reforming to produce hydrogen.

After initial commercial operations establish predictable cash flow forecasts, CTL development by private industry is expected to continue at a pace dictated by normal economic calculations. Such decisions will be based on experience that provides more well-defined comparison of costs between CTL production and alternative investments.

The development economics issue is short-term. Once commercial operation is successfully demonstrated, capital and operating costs will fall as operations become more efficient and the industry matures and learns how to economically develop the resource. If oil prices are maintained at current levels, advanced generation technology will continue to improve, profitability will increase, and the relative economics of oil shale development will become more attractive. Over the longer-term, improving economic operations will attract the additional investment capital needed to expand operations.

Initial CTL production volumes from early commercial operations will be relatively small, but will require a market. The Department of Defense is proposing to test a variety of fuels from domestic unconventional sources for military use and is authorized under the Energy Policy Act of 2005 as well as the Defense Production Act to enter into purchase agreements for such fuels.

Development Economics Plan: Provide an assured market for initial CTL production. The economic risk of an oil price collapse would be largely eliminated if the federal government and state governments enter into contracts to purchase domestic CTL products at a guaranteed minimum price ($/Bbl).

Potential actions to stimulate CTL markets include:

1. **Federal Tax Incentives**: The Task Force has identified a production tax credit as one of several incentives that could have a significant effect on stimulating investment in shale oil development. Properly developed, this incentive could be revenue neutral to the government since shale oil production could replace, barrel for barrel, foreign imported oil. Applying the tax credit for CTL could have a similar effect.

2. **Federal Loan Guarantees**: The Task Force endorses the federal government's activities to provide guidelines and its implementation of EPACT section 1703 and that additional loan guarantees should be considered specifically for CTL.
3. **Royalties:** Establish the royalty rate structure for CTL products.
4. **Federal Procurement:** Examine the benefits and costs of using federal procurement of crude and crude derived products to help create a stable market for initial CTL production. Market assurance programs should include, but not be limited to, DOD programs to procure military fuels and the DOE program to procure oil for the Strategic Petroleum Reserve. DOD has indicated in testimony that, based on the recent request for information for the availability of Fischer-Tropsch fuels for DOD use, the potential fuel providers requested that there be long term purchase agreements and other governmental incentives to foster the production of these fuels. The DOD witness stated that at present only 5 year purchase agreements are authorized by Congress32. The Task Force recommends that congress provide for 15-25 year purchase agreements.
5. **Other Tax Incentives:** Examine the benefits and costs of alternative tax incentives to stimulate initial CTL development. Incentives should include, but not be limited to production tax credit, accelerated depreciation, investment tax credit, and depletion allowance.

Environmental Protection

Objective: Enable industry development and operations while meeting or exceeding public standards for environmental protection.

Strategy:

- Assist industry by governmental support of feasibility designs to develop a better understanding of CTL plants environmental emissions and a strategy for minimizing environmental impacts, including those associated with air, land, water, and wild life.
- Prepare a carbon management strategy.
- Prepare strategies for water resource management, particularly in water short regions.
- Continue research focused on reducing environmental impacts associated with coal gasification-based technologies and facilities.

Rationale for Action: CTL plants would use advanced clean coal gasification technology to produce transportation fuels and/or electric power. Pollutant emissions are expected to be minimal because coal-derived sulfur will be removed and converted into elemental sulfur. Nitrogen oxides will be minimized using low-NOx burners in the turbines and selective catalytic reduction (SCR) in the flue gas stream, and mercury will be removed, perhaps by some combination of pre- and post-combustion processes. Water use will be minimized by using air coolers where possible, and solids emissions will consist of non-leachable slag from the gasification process. Because of the sensitivity of the F-T catalyst to poisons, all contaminants must be removed to near-zero levels (parts-per-billion [ppb] levels) and this ensures that overall plant emissions would be close to zero. For comparison, CTL facilities would produce emissions similar to modern, state-of–the-art coal gasification plants, and could be configured to capture CO_2 by incorporating advanced technologies that are being developed through federal sponsorship today. Table II-4 illustrates recent air permit applications and project information for various integrated gasification combined cycle facilities.[33]

Table II- 4. Federal New Source Performance Standards vs.
Current IGCC Permit Applications and Project Information (lb/MMBtu)

	Current Federal New Source Performance Standards [a]	ERORA Cash Creek Generation (KY)[b]	ERORA Taylorville Energy Center (IL) [b]	Energy Northwest Pacific Mountain Energy Center (WA)[c]	Excelsior Energy Mesaba Energy Project (MN)[c]
NO_X	0.12	0.0246 (w/ SCR)	0.0246 (w/ SCR)	0.012 (w/ SCR)	0.059
SO_2	0.15	0.0117	0.0117	0.006	0.022
PM	0.015	0.0063 (filterable only)	0.0063 (filterable only)	0.01	0.01
CO	N/A	0.036	0.036	0.05	0.03
VOC	N/A	0.0011	0.0011	0.003	0.002

a. Code of Federal Regulations 40 CFR 60
b. Permit application and communication with ERORA
c. Public Information

At present, no requirements exist in the U.S. to manage carbon emissions from fossil fuel sources. However, should carbon management be required, carbon dioxide produced during the conversion process could be captured for subsequent storage in deep saline aquifers or sold for use in enhanced oil recovery (EOR) operations. A study done in 2004 for production of substitute natural gas (SNG) from coal assumed that the value of CO_2 for EOR was $12/ton[34], which would significantly improve the economics of a CTL plant.

With carbon capture and storage, it is expected that CTL plant emissions and the emissions from utilization of CTL products would be comparable to those associated with the production and consumption of petroleum-based fuels. If sequestration of carbon dioxide is required, an additional $4 per barrel for the price of low-sulfur, light crude oil would be required for profitable operation. It has been estimated that a CTL plant with no carbon capture would release about 0.78 tons of carbon dioxide per barrel of product in comparison to a current refinery emitting about 0.1 tons of carbon dioxide per barrel of product. When carbon sequestration is employed for both facilities (90% captured and stored at the CTL plant and 40% at the refinery), the carbon dioxide emissions are equivalent.[35]

The presumption of minimal environmental impact must be validated by both government and private sector studies that address:

- **Criteria pollutant Emissions:** Feasibility designs performed through government-industry partnerships could remove a good deal of uncertainty associated with possible new emissions regulations.
- **Plant Environmental Baseline:** Site-specific early design studies would address where the resources, such as coal and water, are coming from, how they are delivered and how waste products are to be reused or disposed. Site-specific early design studies would provide the ability to obtain information on environmental baselines for the plants. These plants would be ready for CO_2 separation and capture and the information obtained would define resource requirements. Site-specific information would also address where the resources, such as coal and

water, are coming from, how they are delivered and how waste products are to be reused or disposed. Additionally, current R&D activities co-sponsored by DOE and industry are being pursued to improve CO_2 separation and capture and define CO_2 storage sinks.

- **Carbon Management Plans:** CTL plants would be designed to accommodate carbon capture and pressurization technologies for subsequent sequestration in saline aquifers or oil reservoirs for enhanced oil recovery (EOR). Early plants that are configured to sell or demonstrate CO_2 use for EOR would be encouraged. Recent calculations suggest that from a 2.6 MMBD CTL industry, approximately 892,320 BPY could be recovered using CTL CO_2 for EOR. However, each site specific plant would require its own carbon management strategy, e.g., to determine whether conventional or advanced capture technologies are appropriate and to create the criteria and methodology for secure storage. Site-specific early design studies would provide the ability to obtain information on environmental baselines for the plants. These plants would be ready for CO_2 separation and capture and the information obtained would define resource requirements. Site-specific information would also address where the resources, such as coal and water, are coming from, how they are delivered and how waste products are to be reused or disposed. Additionally, current R&D activities co-sponsored by DOE and industry are being pursued to improve CO_2 separation and capture and define CO_2 storage sinks. The DOE Office of Clean Coal has mounted an aggressive program to improve the efficiency of capture and to reduce capture costs.[36] The goal of these efforts, by 2012, is to develop two new capture technologies that each result in less than a 10% increase in the cost of energy services. This new technology, if successful, would be available for application to a growing CTL as well as oil shale industry. A study done in 2004 for production of substitute natural gas (SNG) from coal assumed that the value of CO_2 for EOR was $12/ton[37], which would significantly improve the economics of a CTL plant.

- The Task Force recommends that effective carbon management alternatives be identified, especially to emphasize those strategies that create a value for the CO_2 that will be produced. The DOE created, and is continuing to support regional partnerships that emphasize long term carbon storage options. The carbon management activities sponsored by the DOE can be found at the following web site: http://www.netl.doe.gov/technologies/carbon_seq/index.html

- **Strategies for Water Resource Management:** Water use and water quality issues must be addressed to alleviate regional concerns about CTL production. The Task Force recommends that a regional program for water resource management be developed/ implemented.

<u>Environmental Activities:</u>

Site-specific early design studies would assist in defining the plant technologies and configurations necessary to meet Federal, regional and local environmental requirements, including the meeting potential carbon emission regulations.

Regulatory and Permitting

<u>Objective</u>: Allows expeditious development through a predictable process and schedule for permitting.

<u>Strategy</u>: Review the current regulations, standards, and processes to provide recommendations and implement a methodology to streamline permitting that can

accelerate development, ensure regulatory compliance and provide an effective means for resolving disputes, where appropriate.

Rationale for Action: CTL plants will be required to obtain many permits and approvals, involving all levels of government. While environmental laws have matured and permitting processes have improved, permitting delays can postpone entire projects and threaten their economic viability and thus create a major risk for large CTL projects.

A broad scope of environmental issues may be present in siting a new facility or expanding the capacity of an existing one pursuant to the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, the National Environmental Policy Act and other Federal, state and local laws. Substantial up front work is required regarding site and design factors prior to the submission of an application for a new refinery, chemical or fuel plants such as CTL facilities. Depending on the complexity of the facility and the siting, the permitting process can take between 1 and 2 years after an application is filed. Those seeking to construct a CTL plant may revise their applications after they have been submitted. In addition, administrative appeals during the permitting process and judicial review can add substantially to the time required for final approval.

As mentioned earlier, under current federal environmental law and regulations, state and local authorities consider and approve most of the environmental permits that are required for CTL plants. States may impose separate or additional requirements that can be more stringent than those required for compliance with federal law and regulations. In addition, state and local decision-making with respect to refineries and other large industrial and commercial facilities can frequently involve land use and other local issues, such as conditional use permits, local fire, building and plumbing codes, as well as connections to sewer systems and construction approvals.

Legislative/Regulatory Considerations in the Developing Coal Resources

Coal production in the United States is currently 1.1 billion tons per year. The industry is well developed and regulatory requirements for mines are in place. The following discussion is from the NCC report: "The advent of the environmental movement in the United States in the early 1970's brought with it laws to clean up and protect our air (Clean Air Act) and water resources (Federal Water Pollution Control act). Within the next decade, additional laws were enacted that addressed hazardous wastes and fish and wildlife production."

In 1977, coal mining activities were significantly regulated through the Federal Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87). That Act establishes a "nationwide program to protect society and the environment from the adverse effects of surface coal mining operations and surface impacts of underground coal mining operations and to promote the reclamation of mined areas left without adequate reclamation."

SMCRA addresses virtually every environmental and land use issue associated with coal mining and established standards and protocol for coal operations. The federal regulations needed to implement SMCRA were developed by the newly formed Office of Surface Mining (OSM). The OSM's regulations were more comprehensive than the statute, and they established new levels of both design and performance standards for coal mining operations.

The Task Force recommends that the concerned federal, state, and local agencies cooperatively undertake a review of regulatory requirements and streamline the permitting process. The goal is to improve the predictability of the timelines required to secure permits before construction or operation can begin.

Regulatory/Permitting Activities:

- **Review Requirements:** Review and document existing standards and permit requirements at the local, state, and Federal level.
- **Streamline Permitting:** Develop a methodology to streamline permitting and avoids duplication where it may exist. Prepare and publish a "roadmap" of current permitting processes and timelines in major oil shale states and federal permitting processes. Identify and consider approaches for delegated authorities, or joint or concurrent review. Focus on web-based applications and responses.

Infrastructure

Objective: Review the adequacy of infrastructure to support industry development of CTL production.

Strategy: Coal is dispersed regionally throughout the U.S. Significant progress has been made in coal mining, both in its productivity and safety. These efforts would need to continue, including the opening of new mines, in order to meet the projected increasing demand for electric power generation and a new industry based on producing coal liquids Analysis of public policy, mine siting, and permitting and safety issues would lead to recommendations that can address key infrastructure barriers and also the extent to which accelerated mining research may be needed.

Rationale for Action: Significant deployment of CTL facilities would require the use of large quantities of coal, meaning a significant expansion of the U.S. coal mining industry. For example, an 80,000 BPD CTL plant would use approximately 15 million tons of coal per year. The recent National Coal Council study estimates that a production rate of 2.6 million barrels/day of CTL will require an additional 475 Million ton of coal. This would result in about a 40% increase in demand for coal. Coupled with a similarly projected increase for coal due to electricity demand in 2025, it is clear that mining capacity expansion is a critical issue. If the CTL plants are not sited near the mines, then coal transportation would also become an important issue. The current infrastructure of railroads and railcars used to transport coal and other goods is inadequate to handle this projected increase in demand for coal. Additional barge capacity, particularly in the Midwest and eastern sections of the U.S., may also be required to meet additional coal demand. Significant investments to upgrade and improve the current rail transportation system would be required since rail lines are already congested. Additionally, new roads would be required to accommodate increased private, coal and service vehicles for these CTL plants.

Socio-Economic Planning and Impact Mitigation

Objective: Study the potential socio-economic impacts to assist states and communities with issues that may arise with CTL industry development

Strategy: Support industry and communities in their efforts to mitigate adverse local impacts and maximize state and local job opportunities and economic growth.

Rationale for Action: The CTL plants would likely be located near coal-producing regions to minimize transportation and other logistical costs. A wide swath of rural America from Appalachia through the Midwest, Great Plains and Rocky Mountains will directly benefit from the jobs and economic stimulus these plants will generate. Many communities in these regions have not shared the benefits of the high-tech boom of the 1990s. Instead, many of these communities have suffered from plant closings by companies that could not compete with cheap manufactured imports from Asia. The construction of coal energy conversion plants will revive these communities and help restore the social fabric frayed by years of falling employment, declining income and rising emigration.

Community Impacts[38]

The impacts of CTL plants on local and regional communities would likely be very similar to the impacts generated during the construction and operation of conventional coal-fired power stations. For example, Southern Illinois University estimated in an economic analysis study that the 1,500-megawatt Prairie State electric generating facility in Washington County, Illinois, would inject more than $2.8 billion into the state economy, generate more than $200 million in new tax revenues for state and local governments, create more than 1,800 construction jobs per year during the building of the mine and plant, and create 450 permanent mine and power plant jobs.

These gains are realized as the direct expenditures to build and operate these plants stimulate the demand for goods and services in other sectors of the economy. For example, the construction of CTL plants would increase the demand for steel, concrete and other building materials. There would be subsequent rounds of spending, known as indirect impacts, as these sectors draw on their suppliers. Finally, there are induced impacts from the consumption spending by households from higher income levels generated by the direct and indirect economic impacts. For example, workers at CTL plants would purchase local services which generate income in these sectors.

The vision for coal described in this study would create over 200 coal energy conversion plants scattered from Pennsylvania to Wyoming, each roughly the size of a 1500 MW power plant. Most of these plants would be in rural areas with relatively high unemployment and limited resources for schools and other public services. With the income generated from CTL plants, these communities could restore these services and improve the quality of life for employees and for their neighbors and families.

Rapid growth in a relatively small, concentrated area would greatly expand the demand for municipal and human services, such as police and fire protection, medical services, sanitary facilities, educational services, and transportation. For most of the smaller communities, annual operating costs are about equal to annual revenue. Therefore, capital improvement expenditures are largely financed by municipal bond issues that are constrained by statutory bonding limits tied to property values. It is difficult for small communities to raise capital funds needed to support rapid growth in a timely manner. These communities are also resource-constrained to fund the detailed analysis, planning and initial preparedness activities that must precede industry development.

Under this plan, the Program will work with affected communities to mitigate the adverse impacts associated with rapid growth.

Markets

Objective: Align fuels production with expected market demand.

Strategy: Understand fuels markets, demand for CTL, provide support to the Department of Defense Clean Fuels Initiative and foster contact with civilian application of jet fuels with interested commercial airlines.

Rationale for Action: The Office of the Secretary of Defense has established a Clean Fuel Initiative and is moving aggressively to define and develop a single Battlefield Use Fuel of the Future (BUFF) for use on the ground and in the air. This would reduce the number of military fuels required from 9 to 1. The initiative is designed to simplify supply-chain logistics and reduce tailpipe emissions.

To implement its new initiative, DOD is crafting a fuel specification that meets all its technical requirements for tactical vehicles (aircraft, ground, and ships) while reducing emissions. In April 2006, the Air Force took a pioneering stance when the Secretary of the Air Force, the Honorable Secretary Michael Wynne, set forward a flight demonstration of F-T fuel blend in a B-52 aircraft. This engine demonstration, was successfully conducted in September 2006, and will pave the way for a full qualification of F-T fuel blend for the Air Force fleet. To learn more about industry interest, requirements, and capabilities, the USAF and Navy sponsored, through the Defense Energy Support Center (the purchasing agency for all federal and military fuel), an RFI for the purchase of 200 million gallons total.[39] This cleaner fuel could eliminate the need for future EPA national security exemptions for defense fuels.

A major thrust of the initiative is to manufacture this fuel from domestic energy sources. The most promising sources, according to DOD, are liquid fuels produced from coal, shale oil and petroleum coke, provided they can be made available on a schedule that supports DOD fuels testing, spec development, and fuels-transition timing.

The DOD market could only absorb 300 thousand BPD of coal liquids or shale oil. An integrated market analysis for unconventional fuels is required to assess market demand and product supply including shifting demand from motor gasoline and toward diesel. Other potential early markets are:

Commercial Fleets (Clean Cities): DOE's Clean Cities Program is designed to advance the economic, environmental, and energy security of the U.S. by supporting local decisions to adopt practices that contribute to reduced petroleum consumption in the transportation sector. Today, Clean Cities' stakeholders are currently displacing 15,600 BPD of gasoline equivalent, with a goal to displace 10 times that amount by 2020. Achieving this goal is the equivalent of or taking one supertanker off the high seas every eight days. Coal-derived liquids, which are on DOE's list of acceptable fuels for use in the Clean Cities Program, could help achieve this goal with concurrent emissions reductions associated with using premium F-T diesel fuel. Table II-5 shows how F-T diesel fuel yielded emission reductions when substituted for a high-quality California diesel fuel in a 10.3-liter engine.[40]

Table II- 5. Percent Reduction of Emissions When F-T Diesel Fuel was substituted for High-Quality CA Diesel Fuel in a 10.3 Liter Engine

Emission	Reduction (%)
NOx	12
Particulates	24
Carbon Monoxide	18
Hydrocarbons	40

Home Heating Oil (Northeast Home Heating Oil Reserve): The market demand for home heating oil in the U.S. is approximately 200 MBPD. Of the 7.7 million households in the U.S. that use heating oil to heat their homes, 5.3 million households (69%) reside in the Northeast region of the country – making this area especially vulnerable to fuel oil disruptions. On July 10, 2000, the Administration directed, and the Department of Energy subsequently established, a heating oil reserve in the Northeast capable of assuring home heating oil supply for the Northeast during times of significant threats to immediate supply. The current structure of the Heating Oil Reserve provides the capability of delivering 2 million barrels of heating oil, sufficient to provide protection for 10 days against supply disruption.

Home heating oil is not subject to transportation fuel sulfur limits. The sulfur level ranges between 2,000 and 2,500 ppm, compared to current diesel fuel limits of 15 ppm. Replacing conventional heating oil with low sulfur fuel (such as that produced in the F-T process) would provide local and regional environmental benefits and result in less boiler and furnace maintenance due to reduced iron sulfate buildup on the heat exchangers.[41]

Future Markets: If the benefits of using coal-derived F-T fuel are demonstrated by the military and public sector vehicle fleets, and development of CTL technology proceeds, it is anticipated that the F-T market would expand to personal vehicles and possibly the commercial jet fuel market. The EIA projects a steady increase in fuel economy resulting from more sales of hybrid and diesel-powered vehicles, which bodes well for a future F-T diesel fuel market. Further, incorporation of CO_2 capture and storage at CTL production facilities should result in no greater life cycle greenhouse gas emissions than those accompanying the production and use of conventional petroleum-derived gasoline.

In addition, Sasol has reported that for the past 7 years, aircraft flying from Johannesburg International Airport have used a semi-synthetic blend of 50% jet fuel from coal produced at a Sasol Ltd. CTL refinery, and 50% derived from traditional crude oil refining. Sasol has clearly demonstrated that synthetic jet fuel can be produced from coal; it has been proven in commercial use. Sasol hopes to win final approval this year for use of 100% synthetic fuel, also derived from coal. Coal derived Fischer-Tropsch could be a substantial market in the mid-term. For example, interest has been shown by the U.S. airline JetBlue for Fischer-Tropsch jet fuel and other alternate fuels.[42]

Markets Plan:

1. **Support preparation of DOD fuel specs**. Support the DOD effort to produce a fuel from coal that meets the specs of a single battlefield use fuel.
2. **Support testing of CTL fuels in DOD vehicles**. Work with the industry to obtain and provide fuels for military testing. Help to validate performance.
3. **Prepare a market analysis for unconventional fuels**.
4. **Commercial Jet Fuel**. Conduct a dialogue with commercial airlines that have shown interest in the potential of F-T diesel fuel first as a blend and then as a neat fuel. Identify interest in developing a strategy with the commercial sector for testing and evaluating F-T jet fuel**.**
5. **Incentive and Purchase Analysis**: As previously noted, DOD has indicated in testimony that based on the recent request for information for the availability of F-T fuels for DOD use the potential fuel providers requested that there be long term purchase agreements and other incentives to foster the production of these fuels. The DOD witness stated that at present only 5 year purchase agreements are authorized by Congress[43]. The task Force recommends that congress provide for 15-25 year purchase agreements and that incentive packages be explored/implemented by government.
6. **Evaluate product mixes, coproduced products** – electricity, methanol, ammonia, chemicals which potentially could provide a higher rate of return for early production plants such as the production of fertilizers as the primary product and F-T liquid fuels as a byproduct.
7. **Evaluate the Mechanism for Marketing Products**: Many utilities are still regulated and have to get approvals from state utility regulatory organizations and use utility financing approaches while the energy production industry generally has much less regulatory oversight. Both have regulatory and permitting requirements for new or planned plant expansion. Scenarios should be analyzed to define the preferred approaches for the marketing of products. For example, the synthesis gas could be produced within the plant boundary or provided by a non regulated company over the fence to the product manufacturer, which could be a regulated utility.

CTL APPENDIX

National Coal Council (NCC) Report:
Coal: America's Energy Future

NCC is a private, non-profit advisory body chartered under the Federal Advisory Committee Act (FACA) to provide guidance and recommendations as requested by the U.S. Secretary of Energy on general policy matters related to coal. The members are appointed by the Secretary based on their knowledge, expertise, and stature in their respective fields and reflect a wide geographic area of the United States and diverse interests.

Purpose

This report was developed in response to Secretary Bodman's request in 2005 that the Council "conduct a study and prepare a report identifying challenges and opportunities of more fully exploring our domestic coal resources to meet the nation's future energy needs." The Secretary's letter stated that "The study should also investigate opportunities to use coal in new and innovative ways within sectors of the economy that traditionally have not used coal."

In order to meet this "Manhattan" program the report makes the following key points and recommendations specific to the ramp-up of CTL production:

- Identifies ample amounts of reserves to support 100 GW of new electricity generation, supply 2.6 MMBPD of CTL, 4 TCF of SNG, plus support for ethanol, CBM, and hydrogen by 2025
- Provides a list of recommendations to remove potential barriers to expanded coal production and use:
  - Accelerate research, development, and demonstration of advanced technology by urging Congress to appropriate full funding for all clean coal programs authorized, including FutureGen and the Clean Coal Power Initiative (CCPI)
  - Improve the ability of the industry to attract private capital for new facilities
    - Providing for 100 percent expensing in the year of outlay for any CTL plant begun by 2020
    - Federal loan facility of $100 billion with the ability to provide loan guarantees for the initial commercial scale CTL and CTG plants (see EPAct2005, XVII)
  - Provide market certainty for products by guaranteeing federal government purchases of CTL products
    - Strategic Petroleum Reserve or the Department of Defense, with purchases being based on long-term contracts with floor prices
    - Extending the CTL excise tax exemption to 2020 (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users SAFETEA-LU 2005 extension)
    - Extending the temporary expensing for equipment used in refining to 100 percent of any required additions to existing refineries needed to handle CTL products (see EPAct2005, § 1323)
    - Involving the EPA in the research on fuel performance characteristics to assure the broadest applicability in commercial use
    - Involving the Department of Defense in testing fuels to

optimize plant and process design for the Air Force (jet fuel), Army (arctic diesel), and Navy (marine diesel) requirements.

– Minimize operating costs for new alternative fuel plants by providing royalty (federal and state) relief for coal used to produce either liquids or gas.

– Reduce permitting delays and regulatory uncertainty by expediting permitting with a joint (federal and state) process

  - Exempting initial CTL and CTG plants from New Source Review (NSR) and National Ambient Air Quality Standards (NAAQS) offset requirements

  - Where it has not been done, implementing the recommendations proposed by The National Coal Council in the 2004 report *Opportunities to Expedite the Construction of New Coal-Based Power Plants.*

– Assure that enhanced oil recovery in new basins using CO_2 extracted from coal plants is an attractive investment by

  - Providing federal tax incentives to support taxpayers who invest in railroad infrastructure capacity

  - Urging Congress to appropriate funds for the upgrade of the inland waterway system, including barge access

– Ensure that all existing, identified U.S. economically recoverable reserves remain a part of the resource base by:

  - Seeking balance between precautionary protectionist policies and energy security

  - Supporting active enforcement of existing laws, including The Clean Water Act, the Endangered Species Act, the Surface Mining Control and Reclamation Act, and the Wilderness Act

  - Actively involving the Department of Energy (DOE) in addressing energy security in any policymaking that would "sterilize" significant coal reserves

  - Opposing overlapping and additional regulations that needlessly reduce access to the United States' most abundant energy resource — coal. Recent examples:

    - Last-minute inclusion of the Kaiparowits Plateau in the Grand Staircase-Escalante National Monument designation

    - Forest Service's recently extended Roadless Forest Protection to July 16, 2007.

– Continuing to support the provisions of the Mine Safety and Health Act by ensuring a progressive approach to the important issue of enhancing mine safety and working to provide enhanced funding for mine safety research by the National Institute for Occupational Safety and Health (NIOSH)

– Conduct a thorough and updated survey of U.S. coal reserves

  - Economic benefits derived from meeting the goal of an additional 1.3 billion tons/year of coal production would result in more than $600 billion in increased annual economic growth and 1.4 million new jobs per year by 2025.

HEAVY OIL SUBPROGRAM PLAN

HEAVY OIL SUBPROGRAM PLAN

GOALS AND OBJECTIVES

The goal for a heavy oil research and development (R&D) program is to stimulate and accelerate expanded private industry development of domestic heavy oil resources, resulting in increased domestic production of heavy oil of 0.75 to 1.0 million Bbl/d by 2025. This could be accomplished through the pursuit of an integrated, "basin-oriented" approach, with particular emphasis on those areas with the greatest potential, i.e., Alaska, California, and Wyoming.

An aggressive and accelerated program could increase domestic heavy oil production to 575 MBbl/d by 2012, growing to 960 MBbl/d by 2020, and 1.0 MMBbl/d by 2035.

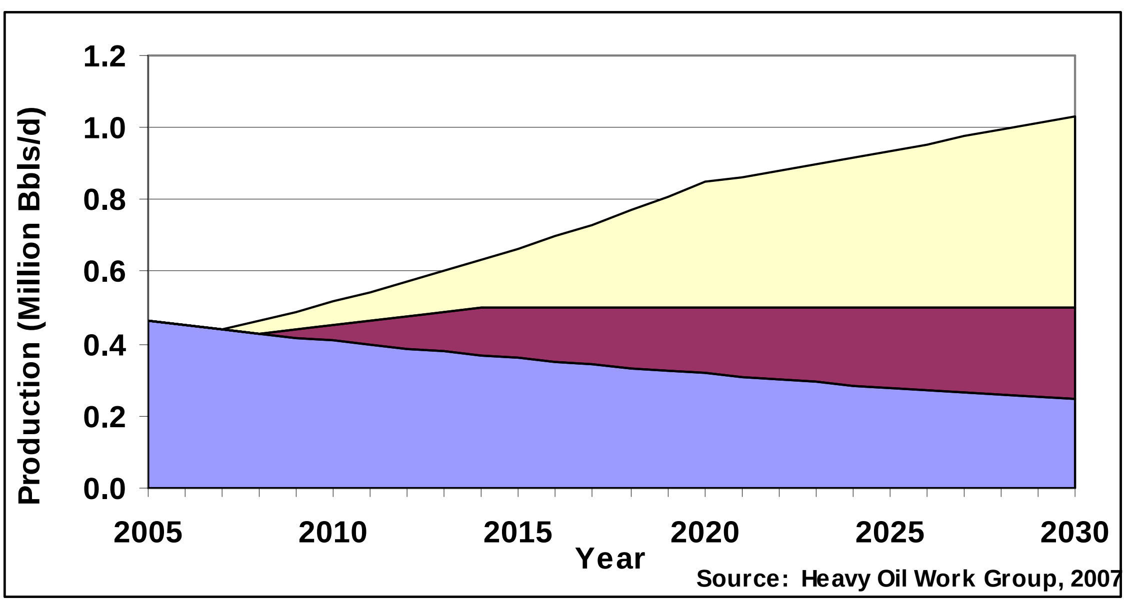
A significant commitment to R&D to expand, enhance, and diversify the application of heavy oil development and production technologies will be required to achieve this production objective.

DEVELOPMENT SCHEDULE

The development schedule assumed in Figure II-39 for the future potential of U.S. heavy oil production was developed under several scenarios:

- A "business as usual" or BAU scenario, which corresponds to the continued forecast production decline of currently producing domestic heavy oil fields.
- A "measured research program" scenario that corresponds to a federal program focused on heavy oil recovery technology.
- An "aggressive research program" scenario that corresponds to a federal heavy oil research program budget that is substantially larger than that in the measured program.

Figure II- 39. United States Heavy Oil Development Schedule*



*Includes Alaska resource, not explicitly modeled in NSURM.

ECONOMIC BENEFITS

The expansion of the heavy oil industry provides potential public benefits. The Federal treasury, state and local governments, and the overall domestic economy will benefit from the direct contributions of a domestic heavy oil industry and from the additional economic activity and growth that will result from industry development. Direct benefits can be measured in terms of:

- direct Federal revenues (from Federal taxes and the Federal share of royalties),
- direct state and local revenues,
- the value of avoided oil imports,
- employment, and
- contribution to GDP.

The economic incentives put in place will determine the volume of heavy oil that is produced. Three cases were used for this program plan to evaluate the effect of economic incentives on heavy oil production and the volume of oil produced:

1. Base Case assumes no incremental heavy oil production.
2. Measured Case assumes AEO 2006 reference prices plus EOR tax credit.
3. Accelerated Case assumes AEO 2006 reference prices plus EOR tax credit.

All analyses are based on the National Strategic Unconventional Resource Model (NSURM)[44] developed specifically for the Task Force by the DOE Office of Petroleum Reserves. The results are not intended to be a forecast rather they represent estimates of potential benefits under given assumptions.

Federal and State Revenues

According to the results of NSURM, with the incentives introduced in the accelerated case, Federal revenues reach $0.2 billion per year by the end of the 25 year period of analysis.

Direct state revenues generated in the accelerated case reach $0.1 billion by 2030.

Total public sector revenues (the sum of direct Federal and state revenues) is shown in Figure II-40. Public sector revenues reach $0.4 billion per year for the accelerated case by 2030. Cumulative public sector revenues through 2030 total $30 billion.

Figure II- 40. Annual Total Direct Public Sector Revenues ($ Billion)

Case	2015	2025	2030
Base	0.0	0.0	0.0
Measured	1.8	0.9	0.4
Accelerated	1.8	0.9	0.4

Value of Imports Avoided

The accelerated case would save the United States $1.0 billion per year by 2030 that would have otherwise been spent on imports.

Figure II-41 displays the value of imports avoided for the 3 cases. Cumulative imports avoided through 2030 total $108 billion.

Figure II- 41. Annual Value of Imports Avoided ($ Billion)

Case	2015	2025	2030
Base	0.0	0.0	0.0
Measured	6.8	2.6	1.0
Accelerated	6.8	2.6	1.0

Employment

Heavy oil industry development will result in the addition of thousands of new, high-value, long-term jobs in the construction, manufacturing, mining, production, and refining sectors of the domestic economy. The NSURM model estimates direct petroleum sector employment based on industry expenditures. The model also approximates the total number of jobs that will be created in the petroleum sector.

Not all of the direct employment shown will be new jobs to the economy. Some will be filled by workers shifting from one industry sector to another. The jobs will not all be in the states where heavy oil development sites are located. Other states that design and/or manufacture trucks, engines, steel, mining equipment, pumps, tubular goods, process controls, and other elements of the physical complex will also share in the jobs creation.

As shown in figure II-42, accelerated heavy oil development will create nearly 800 new jobs.

Figure II- 42. Annual Total Petroleum Sector Employment - Direct & Indirect (K Labor Years)

Case	2015	2025	2030
Base	0.0	0.0	0.0
Measured	8.3	2.2	0.8
Accelerated	8.3	2.2	0.8

Contribution to GDP

The direct contribution to the economy, as measured by the GDP, is significant. By 2030, the annual direct contribution is estimated at $1.0 billion (Figure II-43).

The cumulative contribution to the GDP totals $108 billion through the year 2030.

Figure II- 43. Annual Direct Contribution to GDP

Case	2015	2025	2035
Base	0.0	0.0	0.0
Measured	1.7	7.6	7.0
Accelerated	2.4	10.1	10.8

RESOURCE-SPECIFIC CONSIDERATIONS AND STRATEGIES

"Heavy oil" is an asphaltic, dense, viscous type of crude oil that has API gravity between 10° and 20°. The domestic heavy oil resource is large, on the order of 100 billion barrels of original oil in-place (OOIP), primarily located in California, Alaska, and Wyoming.

Data from the California Department of Conservation shows that the production of heavy oil in California using thermal EOR, water-flooding and primary depletion, while significant at nearly 474 MBbl/d, has been declining since 1998. Of this, about 286 MBbl/d is produced from thermal enhanced oil recovery (EOR) processes. Nationwide, thermal EOR production has also been declining since 1998, today producing approximately 302 MBbl/d from 55 thermal EOR projects, a decline from nearly 346 MBbl/d in 2004. In contrast, heavy oil production from in-situ combustion processes is increasing in the U.S., and a number of new thermal EOR projects are underway or are in the planning stages in Canada. In fact, the Alberta Energy and Utilities Board (EUB) estimates that Alberta bitumen production will likely triple in the next ten years.

Advances in heavy oil recovery technology, particularly steam-based EOR, provide an example of how higher recovery efficiencies are being achieved in shallow heavy oil fields. These technologies have generally been applied to large fields, since smaller fields often have lower profit margins due to the greater capital expense per barrel. Nonetheless, technological improvements and expanded application of state-of-the-art technologies, even in small, shallow reservoirs, will yield greater recovery efficiencies.

Moreover, new heavy oil recovery technologies are evolving to improve their efficiency and expand their applicability, including thermal EOR technologies like steam assisted gravity drainage (SAGD), as well as non-thermal methods such as cold flow with sand production (a cyclic solvent process) and the VAPEX process. While these technologies are primarily being demonstrated for application to the Canadian oil sands resources, their applicability to U.S. heavy oil resources should be investigated.

Unfortunately, a significant portion of the domestic heavy oil resource is in reservoirs that are too deep for efficient application of thermal EOR. Therefore, advances in heavy oil recovery technology are required to efficiently and economically recover this large volume of deep heavy oil. Development of more advanced technologies involving horizontal wells, non-thermal recovery technologies, immiscible CO_2, and advanced thermal EOR technology could significantly increase the recovery of this resource.

Finally, and perhaps most importantly, a large portion of the remaining undeveloped resource base in the U.S. (an estimated 25 to 40 billion barrels) exists on the North Slope of Alaska. Particular emphasis needs to be placed on evaluating technologies that could help recover more of this underdeveloped resource. Advanced oil recovery technologies such as miscibility enhanced CO_2-EOR and CO_2-philic mobility control agents, will be essential for recovering more from the largely undeveloped resource in the Schrader Bluff, West Sak and other formations in Alaska, without disturbing the permafrost.

Given declining conventional oil production on the North Slope, any increase in production in heavy oil will require either upgrading or sufficient lighter oil diluents in order for the oil to be transported through the Trans-Alaska Pipeline System (TAPS). Consequently, strategies will need to be developed to overcome the constraints of developing North Slope heavy oil resources and transporting increasing amounts of heavy oil produced from this region.

MAJOR PROGRAM ELEMENTS

Program elements are:

- Resource access
- Technology advancement and demonstration
- Development economics and investment stimulation
- Environmental protection
- Regulatory and permitting
- Infrastructure
- Socio-economic planning and impact mitigation

Resource Access

While some heavy oil resource underlies public lands, most does not, or the resource is already under lease, such as the massive heavy oil deposits in Alaska. Much of the potential in the U.S. exists in fields within already producing basins with existing leases.

Technology Advancement and Demonstration

Objectives: The primary objectives are to:

- Encourage the wide scale deployment of state-of-the-art heavy oil technologies, and
- Encourage the accelerated development of advanced recovery technologies.

The program would address the primary technical challenges described above to the broader application of "state-of-the-art" heavy oil technologies, and ultimately advanced technologies to improve domestic heavy oil recovery. The focus of the program will be on resources that are too deep for conventional thermal EOR technologies, and the massive resources on the North Slope of Alaska.

Strategy: The two primary strategies are to:

- ***Develop and implement "basin strategies" for deploying state-of-the-art technologies in key heavy oil basins, reflecting their unique reservoir conditions, and the need for pre-commercial R&D and field demonstrations***. This focus on the pursuit of the significant domestic heavy oil resource contained in reservoirs that are too deep for efficient application of traditional thermal EOR technology. Significant focus would be given to the unique geological, reservoir, environmental, and operational challenges associated with the recovery of heavy oil resources in Alaska, including R&D on technologies and processes to produce North Slope heavy oil resources without impacting the permafrost. This would involve assessing the need for "basin-opening" policies and incentives to stimulate public/private partnerships that would help overcome market risks and encourage broad and aggressive application of heavy oil recovery technologies to produce this undeveloped heavy oil. This would involve the initiation, through a competitive, cost-shared solicitation, of a number of demo projects in high potential basins that would address reservoir characterization, feasibility investigations, and pilot-scale field tests to achieve proof-of-concept of heavy oil recovery in these basins.

- ***Enhance the performance of advanced heavy oil recovery technology and expand its applicability, by supporting research efforts through public/private partnerships.*** This would involve improving the fundamental performance of heavy oil recovery technology, and extending its application to deeper, more challenging settings, through R&D and field tests. Advanced thermal EOR approaches such as SAGD, greater use of horizontal wells, and new diversion and mobility control agents, are among the technology pathways that offer promise. Non-thermal methods such as cold flow with sand production, cyclic solvent processes, and the VAPEX process should also be evaluated. Significant gains in reserves may be achieved by expanding the number of heavy oil reservoirs applicable to immiscible CO_2-EOR, such as that in deeper, viscous oil formations.

Program Activities: The program will be composed of five activity areas as follows:

1. Establish "basin-specific" public/private partnerships in key heavy oil basins,
2. Design/implement portfolio of resource characterization studies and field demonstrations to reduce risks,
3. Support R&D efforts to minimize the impact on the permafrost due to heavy oil recovery on the North Slope of Alaska,
4. Initiate collaborative effort with Canada such as technology-sharing and jointly-funded field R&D, and
5. For the Alaska North Slope setting, develop basin strategies to jointly pursue heavy oil resources and light oil resources amenable to recovery from CO_2-EOR.

Rationale for Action: While the U.S. still contains a large heavy oil resource base, production of this resource has been declining. An aggressive and accelerated program could increase domestic heavy oil production to 575 MBbl/d by 2012, growing to 960 MBbl/d by 2020, and 1.0 MMBbl/d by 2025. Without technology advancement and demonstration, heavy oil production is likely to continue to decline.

Technology Schedule: The proposed program is dependent on the level of funding. The extent to which each of these areas would be pursued will depend on the level of funding authorized for the program. For example,

- An initial program would enable a small number of competitive, cost shared "Basin-Oriented" heavy oil recovery technology demonstration projects in 1 or 2 high-potential basin(s), coupled with some relatively low cost Supporting Research entailing laboratory and modeling simulations for innovative, high-volume flood and well design.
- A more aggressive program would cost-share "Basin-Oriented" Technology Demonstration projects in two or three high-potential basins, coupled with more extensive and advanced Supporting Research and Integration Studies would be enabled.
- The most aggressive program would enable cost shared demonstrations projects in up to three high-potential basins, coupled with higher cost, high Supporting Research including multiple research and field trials of the major technology advancements needed to improve recovery efficiency and extend the technology applications to more challenging settings.

Multiple trials reduce risk and increase the probability of producing an especially beneficial technology. Opportunities increase for "game changing" technologies to be developed.

The schedule for technology advancement and demonstration is presented in Figure II-44. Please note that the schedule is the same for all three possible levels of funding, however, the number of cost-shared demonstration projects and the complexity of the supporting research will change with the level of funding actually received.

Development Economics and Investment Stimulation

Objectives: The objectives of this program element would be to reduce the capital risk in investing in high cost heavy projects, as well as reduce the fuel price risk associated with the costs of heavy oil projects.

While the upfront capital costs may not be as high for thermal EOR projects as for most unconventional fuel resources, a critical issue remains the costs associated with generating the steam required for most thermal EOR operations, which generally use natural gas as fuel. High and volatile natural gas prices, combined with high and volatile prices for the produced oil, can make investment in new thermal EOR projects more risky, perhaps, than more traditional recovery processes, or other overseas opportunities.

Encouraging producers (primarily independent producers, which are responsible for most oil production in the U.S. today) to apply thermal EOR technologies, particularly in settings where it has not previously been applied, may be critical to its wide-scale application. Many states already have fiscal incentives in place to encourage the application of EOR technology, including thermal EOR technologies. At the federal level, Section 43 of the U.S. Internal Revenue Code provides producers of a thermal EOR project a tax credit equal to 15% of their qualified EOR costs, phasing out if oil prices rise above a certain level.

Strategy: The strategies to achieve these objectives would involve further investigation and assessment of potential fiscal incentives to encourage investment in heavy oil recovery projects, along with the pursuit of technology demonstrations to reduce operator risk in investing in heavy oil projects. In addition, efforts should be pursued to support cross-cutting analyses of incentives for all strategic unconventional fuels, leading to an integrated suite addressing all these resources.

Environmental Protection

The primary environmental concerns associated with the development of domestic heavy oil resources is potential air emissions, particularly that associated with generating the steam used in most thermal EOR operations. Nearly all existing thermal EOR operations have converted their steam generation facilities from burning lease crude to burning natural gas to reduce the emissions associated with this process. Again, since the much of the heavy oil resource potential exists in already producing fields that are already under lease and development many of the other

Figure II- 44. Technology Advancement and Demonstration Activities and Schedule

	2007				2008				2009				2010				2011				2012			
Technology Advancement Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Basin Oriented Technology Demo.																								
Laboratory Research																								
Simulation Modeling																								

environmental concerns related to oil and gas development and production have already been addressed within the existing regulatory oversight framework for these fields.

Another important environmental issue that will need to be addressed is associated with minimizing the impact on the permafrost of any heavy oil recovery technology applied on the North Slope of Alaska.

Activities to address these concerns primarily involve proactively working with existing regulatory agencies to cost-effectively address air quality concerns, and R&D on technologies and processes to produce North Slope heavy oil resources without impacting the permafrost. Moreover, activities should be pursued to identify and assess the costs and benefits of alternative carbon management options for heavy oil development.

Regulatory and Permitting

Heavy oil development in areas with an established history will be overseen by regulatory bodies with a long history of oversight for domestic operations. However, areas that have not experienced much oil development could face comparable challenges to other unconventional sources of liquid fuels. Moreover, there will be a need to evaluate all infrastructure requirements and associated environmental considerations in the context of an integrated strategic unconventional fuels program.

Infrastructure

Because much of the heavy oil potential is in traditional producing areas, in general, most of the required infrastructure already exists in the area, but may be underutilized due to declining production. Heavy oil development often allows for the more efficient utilization of existing crude oil infrastructure for production and transportation, minimizing impacts.

Large-scale development of heavy oil resources may require some investment in infrastructure enhancements to handle, process, and transport the more viscous, lower quality heavy oil that is produced. This may require the use of diluents added to the heavy oil to improve its ability to flow into the oil pipeline distribution network, and perhaps the need for upgrading facilities to process the heavy oil if it is to be shipped to refineries not equipped to handle the lower quality crude.

However, should the market adequately value these resources this infrastructure, should be built.

Markets

A close and mutually beneficial relationship could and should exist between CO_2-EOR and heavy oil, as well as other potential alternative sources of liquid fuels, including coal liquids, oil shale, and oils sands. The development of all of these resources has a large “CO_2 footprint,” but the CO_2 emissions from heavy oil development could help further the development of resources potentially amenable to CO_2-EOR.

Socio-Economic Planning and Impact Mitigation

In case of the development of heavy oil resources, since much of the resource identified to date exists in already producing basins, many of the socioeconomic and community infrastructure concerns relate to sustaining or increasing production in areas otherwise experiencing, or that are likely to experience, a decline in production without the pursuit of additional heavy oil resource potential. If production declines in these traditional producing areas, it will significantly impact the local economy, and reduce the government revenue basis that helps support community infrastructure and services. In other words, heavy oil development can prevent substantial economic impacts that could occur to local populations and economies should production decline, by sustaining or perhaps even increasing oil production in the area.

CO_2 EOR
SUBPROGRAM PLAN

CO_2 ENHANCED OIL RECOVERY SUBPROGRAM PLAN

GOALS AND OBJECTIVES

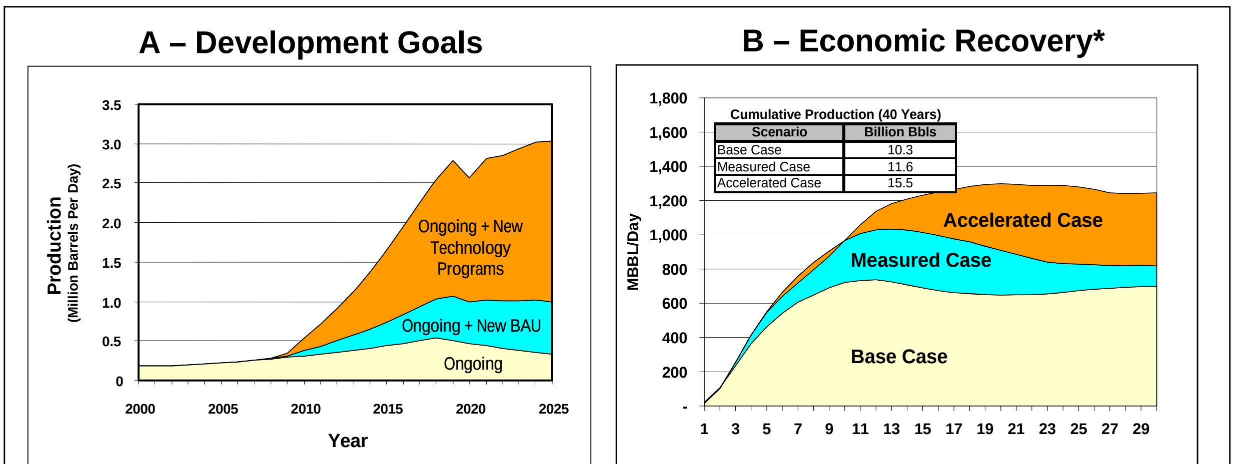
The goal for CO_2 EOR is the expansion and diversification of a CO_2 EOR industry producing over 2 MMBbl/d of oil by 2035 using mostly industrial sources of CO_2. This would be accomplished through the pursuit of an integrated, "basin-oriented" approach to CO_2 EOR involving an emphasis on mature domestic oil basins. A unique strategy would be pursued for each basin, reflecting its special conditions, its opportunities for producing, aggregating and transporting low-cost CO_2, and its needs for pre-commercial field research and pilot-size demonstration tests to establish commercial-scale CO_2 EOR.

Pursuit of this major strategic initiative would address two complementary issues of high priority to the Administration and the Nation:

- Improving energy security by significantly expanding domestic oil production, particularly from maturing U.S. basins.
- Helping meet the President's 2012 goal of reducing carbon (CO_2) intensity by 18%.

Preliminary estimates indicate that the accelerated development and application of CO_2 EOR technology could have a potential target of 500 MBbl/d by 2012, and 2 million (or more) Bbl/d of oil production by 2020 (Figure II-45A). These estimates were derived from the ten (10) extensively reviewed basin studies conducted by the DOE Office of oil and Natural Gas. Figure II-45B shows the economic recovery potential of CO_2 EOR under a set of economic, market, and technology assumptions. The estimates in Figure II-45B were derived from database and models available through the DOE National Energy Technology Laboratory (NETL). The estimates assume the AEO 2006 Reference Oil Prices as published by the EIA. It also assumes building of required infrastructure for delivery of CO_2 from the source to the oil fields. These estimates are also provided for the base, measured, and accelerated cases as defined in the Commercialization Strategy and Summary Plan document (Volume I).

Figure II- 45. United States CO_2 EOR Target Development



*Please note the difference in scale between 1A and 1B

Increased oil production would generate thousands of well paying domestic jobs, reduce U.S. expenditures on oil imports, and generate substantial additional government revenues at the Federal, state, and local level. Moreover, productively using industrial CO_2 emissions as the source for CO_2 EOR could result in reducing CO_2 emissions by 50 million tons by 2012 and 200 million tons by 2020.

DEVELOPMENT SCHEDULE

Preliminary estimates of the future potential production from CO_2 EOR projects in the U.S. were developed for three scenarios:

- A base case, corresponding to a forecast for fields currently under CO_2 flooding.
- A measured case representing modest expansions primarily in areas where CO_2 EOR is currently taking place.
- An accelerated case that corresponds to dramatic increases in the application of CO_2 EOR technology, both state-of-the-art and advanced that could result from a very aggressive R&D program or from dramatic changes in U.S. policy associated with reducing emissions of greenhouse gases (GHGs).

ECONOMIC BENEFITS

The expansion of the CO_2 EOR industry provides potential public benefits. The Federal treasury, state and local governments, and the overall domestic economy will benefit from the direct contributions of a larger CO_2 EOR industry and from the additional economic activity and growth that will result from industry development. Direct benefits can be measured in terms of:

- direct Federal revenues (from Federal taxes and the Federal share of royalties),
- direct state and local revenues (from state and local taxes plus the state share of federal royalties),
- the value of avoided oil imports,
- employment, and
- contribution to gross domestic product (GDP).

The economic incentives put in place will determine the volume of oil that is produced. Three cases were used for this program plan to evaluate the effect of economic incentives on CO_2 EOR production and the accompanying volume of oil produced:

1. Base Case assumes AEO 2006 reference prices, no economic incentives, and a HCPV of 0.4.
2. Measured Case assumes AEO 2006 reference prices, the existing EOR tax credit, and a HCPV of 0.4.
3. Accelerated Case assumes AEO 2006 reference prices, the existing EOR tax credit, and a HCPV of 1.5.

All analyses are based on the National Strategic Unconventional Resource Model (NSURM) developed specifically for the Task Force by the DOE Office of Petroleum Reserves. The results are not intended to be a forecast of what will occur; rather, they represent estimates of potential benefits under the economic and technological assumptions of each case.

Federal and State Revenues

According to the results of the NSURM, direct Federal revenues generated in the base case would reach $2.6 billion per year by 2035. With the incentives introduced in the accelerated case, Federal revenues reach $4.1 billion per year by the end of the 30 year period of analysis.

Direct state revenues generated by the base case are $0.9 billion per year in 2035. In the accelerated case, state revenues reach $1.4 billion by 2035.

Total public sector revenues (the sum of direct Federal and state revenues) are shown in Figure II-46. Public sector revenues reach $3.4 billion for the base case and $5.5 billion per year for the accelerated case by 2035. Cumulative public sector revenues through 2035 total $79 billion for the base case and $98 billion for the accelerated case.

Figure II- 46. Annual Total Direct Public Sector Revenues ($ Billion)

Case	2015	2025	2035
Base	3.0	2.8	3.4
Measured	2.8	2.9	3.3
Accelerated	2.6	4.0	5.5

Value of Imports Avoided

The base case production of CO_2 EOR oil would replace imported oil at the order of $17 billion per year by 2035. The accelerated case would save the United States $26.1 billion per year by 2035 that would have otherwise been spent on imports.

Figure II-47 displays the value of imports avoided for the 3 cases. Cumulative imports avoided through 2035 total $420 billion for the base case and $590 billion for accelerated.

Figure II- 47. Annual Value of Imports Avoided ($ Billion)

Case	2015	2025	2035
Base	15.7	15.8	17.0
Measured	16.0	17.6	17.2
Accelerated	17.2	26.0	26.1

Employment

CO_2 EOR industry development will result in the addition of thousands of new, high-value, long-term jobs in the construction, manufacturing, mining, production, and refining sectors of the domestic economy. The NSURM model estimates direct petroleum sector employment based on industry expenditures. The model also approximates the total number of jobs that will be created in the petroleum sector.

Not all of the direct employment shown will be new jobs to the economy. Some will be filled by workers shifting from one industry sector to another. The jobs will not all be in the states where CO_2 EOR development sites are located. Other states that design and/or manufacture trucks, engines, steel, mining equipment, pumps, tubular goods, process controls, and other elements of the physical complex will also share in the jobs creation.

Accelerated CO_2 EOR development will create nearly 59,000 new jobs by 2035. The base case employment is significantly lower as shown in Figure II-48.

Figure II- 48. Annual Total Petroleum Sector Employment - Direct & Indirect (K Labor Years)

Case	2015	2025	2035
Base	51.6	54.2	41.7
Measured	51.9	57.2	43.7
Accelerated	59.4	90.9	58.8

Contribution to GDP

The direct contribution to the economy, as measured by the Gross Domestic Product (GDP), is significant. By 2035, the annual direct contribution is estimated at $26.8 billion for the accelerated case (Figure II-49).

The cumulative contribution to the GDP for the base case totals $458 billion. For the accelerated case, the cumulative direct GDP contribution totals $644 billion through the year 2035.

Figure II- 49. Annual Direct Contribution to GDP

Case	2015	2025	2035
Base	18.3	16.8	16.8
Measured	18.6	18.4	17.1
Accelerated	19.8	28.0	26.8

RESOURCE SPECIFIC CONSIDERATIONS AND STRATEGIES

CO_2 EOR technologies have been demonstrated to be profitable in commercial scale applications for nearly 30 years. Currently, 82 CO_2 EOR projects provide 237 MBbl/d of production. Ten years ago, production from CO_2 EOR was only 170 MBbl/d. In just the last 5 years, a number of players have entered the CO_2 EOR business.

Production continues to increase in Encana's Weyburn CO_2 flood in Canada, with current production at 6,500 barrels per day of incremental oil. This project buys its CO_2 from the Dakota Gasification Synfuels plant in Beulah, North Dakota. Apache Canada has also started CO_2 injection in the Midale field, also using CO_2 from this gasification facility.

Despite this strong historical foundation, substantially more potential could be pursued through the more wide spread application of CO_2 EOR technologies. Congressional Budget language for Fiscal Years 2004 and 2005 directed that the DOE Oil Program conduct "basin-oriented" assessments to "examine new steps to accelerate adoption of CO_2 EOR." The Budget for 2006 continued this direction with emphasis on "productively using industrial sources of CO_2."

In response, DOE performed an assessment of the status of CO_2 EOR and examined how this technology could augment domestic oil supplies and encourage productive use of industrial CO_2. Three sets of extensively reviewed assessments were prepared. The first was a set of 10 basin studies to assess the "size of the prize" for CO_2 EOR technology in specific areas of the country, and identify and characterize the set of policies and economic conditions that would facilitate productive use of industrial CO_2 to facilitate the development of domestic resources using CO_2 EOR. They conclude that today's oil recovery practices leave behind a large resource of "stranded oil" – amounting 390 billion barrels in the regions studied. Such stranded oil represents a target for new technology. The 10 regions have a technically recoverable potential of almost 89 billion barrels using "state-of-the-art" CO_2 EOR technologies; depending on technology and financial conditions, from 4 to 47 billion barrels could be economically recovered.

The second set of activities involved examining how potential "next generation" CO_2 EOR technology could increase the "size of the prize" and further support productive use of industrial CO_2. A report was published that reviews the performance and technical limitations of past CO_2 EOR floods, both successful and unsuccessful. The report sets forth theoretically and scientifically possible advances in technology for CO_2 EOR, and examines, using reservoir simulation, how much these "next generation" CO_2 EOR technologies would improve oil recovery efficiency and expand the CO_2 storage capacities of existing oil reservoirs. Five potential next generation or "game changer" advances in CO_2 EOR technology were postulated. While the possible technologies described in the report have yet to be fully developed or demonstrated, the report demonstrates that the wide-scale implementation of such next generation CO_2 EOR technologies have the potential to increase domestic oil recovery efficiency from about one third to over 60 percent of the original oil in place (OOIP), doubling the technically recoverable resources in six domestic oil basins/areas studied to date.

The third set of activities involved addressing the question of whether there is a larger than traditionally viewed domestic oil resource base that is applicable to CO_2 EOR. Five reports introduce a potential new, unconventional oil resource that can be added to the U.S. domestic oil resource base. This is residual oil in the transition zone (TZ) or residual oil zone (ROZ) below the traditional oil-water contact that exists in many domestic oil reservoirs. This resource has not previously been included in official U.S. domestic oil resource databases or assessments. Typically, the "producing oil-water" contact for a reservoir is set at the first occurrence of free water. This ROZ can exist below this "producing oil-water" contact due to capillary effects, hydrodynamics, and basin tilt. Reservoir simulation shows that, with proper design, CO_2 EOR can technically (and economically) recover a significant portion of this previously unaccounted for crude oil resource.

MAJOR PROGRAM ELEMENTS

Program elements needed to support private CO_2 EOR development are:

- Resource access
- Technology advancement/demonstration
- Development economics and investment stimulation
- Environmental protection
- Regulatory and permitting
- Infrastructure
- Socio-economic planning and impact mitigation

The objective, strategy, rationale for action, activity plans, and schedule are presented and discussed when applicable to each element.

Resource Access

While some potential resources amenable to CO_2 EOR technologies underlie public lands, the vast majority does not, and all of the potential identified in the DOE reports referenced above exist in *already producing fields*, implying that leases for these fields have already been granted. Consequently, access to Federal lands is not a constraint with regard to developing CO_2 EOR in the United States.

Technology Advancement/Demonstration

Objectives: The implementation of an R&D program to address the technical challenges to the broader application of "state-of-the-art" and advanced CO_2 EOR technologies to would have 3 primary objectives:

- Wide deployment of state-of-the-art CO_2 EOR technologies,
- Development of advanced CO_2 EOR technologies, and
- Development of "EOR-Ready" CO_2 supplies.

Strategy: The corresponding strategies are:

- ***Pursue "basin strategies" for deploying state-of-the-art CO_2 EOR technologies in key oil basins***, reflecting their unique reservoir conditions, opportunities for accessing low-cost CO_2 supply, and need for pre-commercial R&D and field demonstrations. This could involve assessing the need for "basin-opening" policies and incentives to stimulate public/private partnerships that would help overcome market risks and encourage broad and aggressive application of CO_2 EOR to produce the "stranded oil" in mature domestic oil basins. In addition, the effort would involve the initiation, through a competitive, cost-shared solicitation, of a number of demonstration projects that would address reservoir characterization, feasibility investigations, and pilot-scale field tests to achieve proof-of-concept of state-of-the-art CO_2 EOR technologies in high potential basins.
- ***Support public/private partnerships, to enhance the performance of advanced CO_2 EOR technology***. This would involve improving the fundamental performance of CO_2 EOR technology through R&D and field tests, to enable more of the oil reservoir to be recovered by the injected CO_2. Advanced CO_2 EOR flooding approaches such as gravity-stable CO_2 injection, greater use of horizontal wells, new cost-effective, high resolution seismic imaging technologies, and new CO_2 diversion and mobility control agents are among the technology pathways that offer promise. In addition, significant gains in reserves may be achieved by expanding the number of geologically challenging oil reservoirs applicable to CO_2 EOR, such as deeper, viscous oil and naturally fractured formations. A strong program of technology transfer would help introduce advanced CO_2 EOR technologies to domestic independents.

- ***Pursue efforts to develop improved, cost-effective technology for capturing and supplying "EOR-Ready" CO_2.*** This would focus on sources of CO_2 from oil refining, gas processing, hydrogen production and other industrial facilities.

The proposed effort would support several major provisions of EPACT, including Section 963, which addresses R&D related to carbon capture and storage, Section 965, which addresses R&D to improve domestic oil and gas production, and Section 354, which provides for incentives to stimulate the application of CO_2 EOR technologies on federal onshore and offshore resources.

<u>Program Activities:</u> There are 3 major activities needed to complete the objective:

- Implement "basin strategies" for deploying state of the art CO_2 EOR technologies in key oil basins,
- Support efforts to enhance the performance of current and advanced CO_2 EOR technology, and
- Develop improved, cost-effective technology for capturing and supplying "EOR-ready" CO_2.

<u>Rationale for Action:</u> Preliminary estimates indicate that the successful, accelerated development and application of CO_2 EOR technology could increase domestic oil production by 500 MBbl/d by 2012 and by 2 MMBbl/d (or more) by 2020. Moreover, productively using industrial CO_2 emissions as the source for CO_2 EOR could result in reducing CO_2 emissions by 50 million tons by 2012 and 200 million tons by 2020.

<u>Technology Schedule:</u> The proposed program is dependent on the level of funding. For example,

- An initial program would enable a small number of competitive, cost shared "Basin-Oriented" Technology Demonstration projects in one high-priority basin, coupled with some relatively low cost Supporting Research entailing laboratory and modeling simulations for innovative, high-volume flood and well design would be supported.
- A more aggressive program would cost-share "Basin-Oriented" Technology Demonstrations projects in two high-priority basins, coupled with more extensive and advanced Supporting Research and Integration Studies, to include research to address more significant and difficult technology advancements needed for high oil recovery efficiencies – e.g., improved mobility control and miscibility enhancers would be enabled.
- The most aggressive program would enable cost shared "Basin-Oriented" Technology Demonstration projects in up to four high-priority basins, coupled with higher cost, high scholastic Supporting Research including multiple research and field trials of the major technology advancements needed to improve recovery efficiency: high volume floods; improved well design; improved mobility control and miscibility enhancement.

Multiple trials reduce risk and increase the probability of producing an especially beneficial technology. Opportunities increase for "game changing" technologies to be developed. The expanded program will increase nearby sequestration options for unconventional fuels facilities, power plants, and other sites that will capture CO_2.

An aggressive program for productively using industrial CO_2 emissions as a source for CO_2 EOR could be pursued jointly with a CO_2 EOR focused research program, since CO_2 supply is the primary block to increased use of CO_2 EOR. It is recommended that this be added to the program. Supplemental funding would enable the development and demonstration of technologies for capturing

Figure II- 50. Technology Advancement and Demonstration Activities and Schedule

	2007				2008				2009				2010				2011				2012			
Technology Advancement Activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Basin Oriented Technology Demo.																								
Laboratory Research																								
Simulation Modeling																								

EOR-ready supplies of CO_2 from industrial sources, focusing on oil refining, oil and gas processing, hydrogen and other industrial plants, and long-term focus "zero-emissions" R&D on options for co-production of "EOR-Ready CO_2" from industrial facilities, perhaps resulting in reducing CO_2 emissions by 50 million tons by 2011 and by 200 million tons by 2020. This work would augment the work of the Carbon Sequestration program that is focusing on coal-fired electric generating plants. Efforts could also be expanded with this funding to develop processes and systems to use the CO_2 from other unconventional fuels processes, such as those producing liquids for oil shale, tar sands, and coal.

The schedule for technology advancement and demonstration is presented in Figure II-50. Please note that the schedule is the same for all three possible levels of funding, however, the number of cost-shared demonstration projects and the complexity of the supporting research will change with the level of funding actually received.

Development Economics and Investment Stimulation

<u>Objectives</u>: The objectives of this program element are to reduce the capital risk in investing in high cost CO_2 EOR projects, as well as reduce the fuel price risk associated with the costs of CO_2 EOR projects.

While the upfront capital costs may not be as high for CO_2 EOR projects as for most other unconventional fuel resources, a critical issue remains encouraging the development of sources of CO_2 supplies, along with encouraging producers (primarily independent producers, which are responsible for most oil production in the U.S. today) to apply CO_2 EOR technologies, particularly in areas where it has not previously been applied. Many states already have fiscal incentives in place to encourage CO_2 EOR technology application. At the federal level, Section 43 of the U.S. Internal Revenue Code provides producers of an EOR project a tax credit equal to 15 % of their qualified EOR costs, phasing out if oil prices rise above a certain level, i.e. $28 per barrel (in 1991 dollars). In order to be eligible for the credit, the taxpayer must employ certain tertiary recovery methods, such CO_2 injection. Qualified costs for a CO_2 injection project include the costs of all new wells associated with the CO_2 flood, the capital costs of a CO_2 recycle plant, and the costs associated with both purchasing and recycling CO_2.

Moreover, EPAct contained provisions that authorized federal royalty relief to encourage application of CO_2 EOR on federal lands (Section 354), federal loan guarantees for projects that "avoid, reduce, or sequester … anthropogenic emissions of greenhouse gases (Title XVII), and the establishment by DOE of a grant program for CO_2 EOR demonstrations in the Williston Basin and Cook Inlet (Section 354(c)).

<u>Strategy</u>: The strategies to achieve these objectives is to pursue further investigation and assessment of potential fiscal incentives to encourage investment in CO_2 EOR projects, along with the pursuit of technology demonstrations to reduce operator risk in investing in CO_2 EOR projects. In addition, further investigation and assessment of potential fiscal incentives to encourage investment in and the development and

delivery of "EOR-ready" CO_2 supplies to these projects is warranted. Finally, efforts should be pursued to support cross-cutting analyses of incentives for all strategic unconventional fuels, leading to an integrated suite addressing all these resources.

Environmental Protection

Environmental concerns exist with the development of resources amenable to CO_2 EOR that are quite different than other unconventional fuels resources. Again, since the most of the resource potential exists in already producing fields, many of the environmental concerns related to oil and gas development and production have already been addressed within the existing regulatory oversight framework for these fields.

However, one important aspect of developing the potential resources amenable to CO_2 EOR technology is that it can provide a significant market for "EOR-Ready" CO_2, particularly from new industrial sources, which could include sources associated with unconventional fuels projects. In addition, the refining and gas processing sectors of the oil and gas industry produce large volumes of CO_2 emissions. These sources can provide a significant, cost-effective method for reducing large volumes of CO_2 that would otherwise be emitted to the atmosphere, and minimize the impact of these emission on potential global warming; i.e., it can provide a major environmental benefit.

Future oil prices and the cost of "EOR-ready" CO_2 will determine how much of this large market may be economically captured. Natural sources of CO_2 currently provide about 2 Bcf per day to CO_2 EOR operations, which will only meet a portion, 40 to 50 Tcf, of this market demand for CO_2.

Therefore, industrial sources of CO_2, which currently only provide about 0.5 Bcf per day will need to be expanded dramatically to meet the remainder of the market requirements that will be necessary to satisfy the potential demand for CO_2 in CO_2 EOR projects. For example, as much as 2.2 Bcf per day could be provided just from refineries located in the states containing the 10 basins/areas that were the subject of the DOE studies referenced above. This includes CO_2 emissions from hydrogen plants, FCC units, and refinery process heaters.

Regulatory and Permitting

Some environmental concerns are associated with the potential large scale injection and subsequent storage of CO_2. Operationally, regulation of CO_2 injection is well established in the U.S., and the environmental performance of CO_2 EOR has been demonstrated in over 80 U.S. oil fields. In Texas alone, for example, there are over 52,000 permitted injection wells, with over 10,000 permitted to inject CO_2, and 8,000 injecting CO_2 exclusively.

This CO_2 is injected into natural traps; more is known geologically about producing oil and gas fields than any other geologic CO_2 storage option under consideration. However, the key issue related to long term storage will be the extent to which it can be guaranteed that the CO_2 will be "permanently" sequestered, and how this "permanence" will be defined.

Efforts are currently well underway to address concerns about permanent CO_2 storage, including those by the International Energy Agency (IEA), the European Union, the U.S. Environmental Protection Agency (EPA), and the Interstate Oil and Gas Compact Commission (IOGCC) (an organization of state governors from oil and gas producing states in the U.S.) to develop regulatory guidelines for CO_2 storage. Also, a number of additional efforts at "real-world" applications can provide information and help guide processes to address this issue, including:

- Regulatory experiences and requirements associated with CO_2 EOR projects in Canada (in the province of Saskatchewan) such as the Weyburn project.

- Experiences and issues associated with processes for obtaining experimental CO_2 injection well permits being sought as part of the DOE's Regional Sequestration Partnership Phase II demonstration projects.
- Ongoing activities to develop industry best practices for CO_2 injection and sequestration, such as activities underway by the American Petroleum Institute, International Petroleum Industry Environmental Conservation Association, the Ground Water Protection Council, and the CO_2 Capture Project.

Infrastructure

Because CO_2 EOR will generally be applied in traditional producing areas, most of the required crude oil infrastructure already exists in these areas, but may be underutilized due to declining production. CO_2 EOR development often allows for the more efficient utilization of existing oil production and transportation infrastructure, minimizing impacts.

On the other hand, large-scale development of resources amenable to CO_2 EOR technologies will require substantial investment in infrastructure to bring CO_2 to these fields. To facilitate this, new laws and regulations may be required for CO_2 pipeline construction and eminent domain/ condemnation for pipeline rights-of-way.

Markets

A close and mutually beneficial relationship could and should exist between CO_2 EOR and other potential alternative sources of liquid fuels, including coal liquids, oil shale, and oils sands. The development of all of these resources has a large "CO_2 footprint," but the CO_2 from these developments could help further the development of resources potentially amenable to CO_2 EOR.

Socio-Economic Planning and Impact Mitigation

In case of the development of resources amenable to CO_2 EOR, since the resource identified to date exists in already producing fields, many of the socioeconomic and community infrastructure concerns relate to sustaining or increasing production in areas otherwise experiencing, or that are likely to experience, a decline in production without the application of CO_2 EOR. If production declines in these traditional producing areas, it will significantly impact the local economy, and reduce the government revenue basis that helps support community infrastructure and services. In other words, CO_2 EOR development prevents substantial economic impacts that could occur to local populations and economies should production decline, by sustaining or perhaps even increasing oil production in the area.

SOCIO-ECONOMIC CROSS-CUT PLAN

SOCIO-ECONOMIC CROSS-CUT PLAN

GOALS AND OBJECTIVES

The overall program goal is to stimulate private industry development of a domestic unconventional fuels industry capable of producing over 6 million Bbl/d of liquid fuels by 2035. The objective of this socio-economic cross-cut plan is to ensure states and communities are prepared to handle the social and community impacts associated with industry development. To support this objective, this plan will support development planning, funding, and training to avoid or mitigate adverse local impacts and maximize state and local job opportunities and economic growth.

UNCONVENTIONAL FUELS SOCIO-ECONOMIC IMPACTS

Unconventional fuels development, whether coal to liquids, oil shale, or tar sands production, may significantly impact the social, cultural, and economic well-being of small cities located in areas near the development site. Industry activity will first lead to a rapid increase in temporary construction workers. This initial buildup will be followed by the more permanent workers needed to operate the new facilities. Both worker groups will need to be supported by a wide variety of service personnel that range from grocery store operators to doctors.

Based on past experience, the influx of people needed to build, operate, and support major energy facility development is reasonably predictable. Demands for community services are also predictable. Major community support elements (that change over time) are:

- Temporary housing,
- Permanent housing,
- Electricity,
- Water treatment,
- Sewage disposal,
- Schools,
- Hospitals, fire, police, and
- New roads and upgrades.

Of the unconventional energy sources, oil shale development in Colorado, Utah, and Wyoming has the most potential to significantly alter the economic and community life in each state.

The area of probable development is primarily rural, with resource extraction, agriculture, and recreation as the activities providing the majority of employment and income. Each area is sparsely populated, with a small number of towns providing the focus of economic and community life. The scale and rapid pace of oil shale project development will likely mean a large increase in population as workers migrate into the area to fill oil shale project construction and operation positions, in many cases accompanied by family members. The influx in population is likely to substantially change the demand for housing and public services in local areas as migrant workers soon occupy vacant housing and temporary accommodations.

The predictable result is to overstress local public services, in particular schools, hospitals, fire prevention and public safety operations. Population increases are likely to be rapid, and, in the absence of adequate planning measures, local communities are unlikely to be able to successfully handle the large number of new residents. Consequently they will experience local social disruption and changes in social organization, impacting the perceived quality-of-life, impacting cultural values, and environmental justice.

The socioeconomic impacts from Coal-to-Liquids (CTL) development will be less severe where plants are dispersed about the country and/or located near existing mines or rail centers. CTL development sites that are not located near existing development and/or infrastructure will have impacts similar to oil shale development.

SOCIO-ECONOMIC IMPACT EXAMPLES

Historical experience with industry development provides a solid foundation needed to support orderly community development associated with the growth of an unconventional fuels industry.

The 1973 Prototype Oil Shale Leasing Program (Colorado)

Oil shale is located in a very sparsely settled area on the western slope of the Rocky Mountains. The shale deposits are bounded in Colorado by the small towns of Rangely, Meeker, Rifle, and Grand Valley. Glenwood Springs, a larger resort community, is approximately 75 road miles east of the Parachute Creek area; Grand Junction, the area's major trade and services center, is approximately 110 road miles west of the center of potential development. Vernal, Utah is just north of the major Utah oil shale resources.

Production may not coincide with socio-economic impact. Not all communities will grow at the same pace even in the same areas. Rifle, Colorado was significantly impacted with a 33 percent population growth in a single year; Meeker had slower growth being relatively isolated from public leases; and Rangely was not significantly impacted by population growth since it had no road access to the development sites.

Rapid growth greatly expanded the demand for community services, such as police and fire protection, medical services, sanitary facilities, and transportation. For most of the smaller communities impacted by development, annual operating costs are about equal to annual revenue. Therefore, capital improvement expenditures are largely financed by municipal bond issues that are constrained by statutory bonding limits tied to property values.

For example, Rifle, CO experienced a population growth from 2,250 to 3,000 in the first year of development. Capital and one-time front end costs needed to support the increased population totaled $6.0 million. At that time, the Rifle bonding capacity was only $0.8 million. There was no way that Rifle or other similar small communities could rapidly raise the capital funds needed to support rapid population growth.

Recognizing the need to fund needed capital improvements, Colorado dedicated a part of its lease bonus payments provided under the 1973 Prototype Oil Shale Leasing Program to a fund aimed at community infrastructure. Distributions from the fund from 1975 through 1979 totaled $29.6 million for specific projects including Meeker streets and drainage and Rifle municipal water.

The bonus payments did not entirely cover all of the needed services. The communities then worked with its industry partners to help pay for a portion of these needed services to help assure that their employees would have access to needed community services.

Coal to Liquids (CTL) Plants

The impacts of CTL plants on local and regional communities would likely be very similar to the impacts generated during the construction and operation of conventional coal-fired power stations. For example, Southern Illinois University estimated in an economic analysis study that the 1,500-megawatt Prairie State electric generating facility in Washington County, Illinois, would inject more than $2.8 billion into the state economy, generate more than $200 million in new tax revenues for state and local governments, create more than 1,800 construction jobs per year during the building of the mine and plant, and create 450 permanent mine and power plant jobs.

These gains are realized as the direct expenditures to build and operate these plants stimulate the demand for goods and services in other sectors of the economy. For example, the construction of CTL plants would increase the demand for steel, concrete and other building materials. There would be subsequent rounds of spending, known as indirect impacts, as these sectors draw on their suppliers. Finally, there are induced impacts from the consumption spending by households from higher income levels generated by the direct and indirect economic impacts. For example, workers at CTL plants would purchase local services, such as dining, entertainment and health care, which generate income in these sectors.

Over 42 coal energy conversion plants scattered from Pennsylvania to Wyoming will be needed to achieve a production goal of 2.6 million Bbl/d by 2035. Most of these plants would be in rural areas with relatively high unemployment and limited resources for schools and other public services. With the income generated from CTL plants, these communities could restore these services and improve the quality of life not only for employees at the plants but also for their neighbors and families.

These plants are not likely to be built using Federal leases. They are also likely to be owned and operated by a utility company that could more easily plan for local services and mitigate disruptions as in the Kentucky example with Toyota given below.

Current Natural Gas Development (Wyoming)

Development of unconventional fuels must also consider the resource demands for conventional resource development. For example, Wyoming is in the midst of a natural gas boom, both with deep gas drilling and coal bed gas methane developments. Natural gas drilling involves a large initial drilling effort with lessening intensity as drilling gives way to a far smaller maintenance staff. The large number of workers needed for initial natural gas drilling tends to live somewhere else and are brought to the locality, often for two-weeks on and two-weeks off. These people live in temporary housing, creating a need for motels and restaurants. They do not contribute to the tax base for schools, social or municipal services.

Sublette County, Wyoming, is a good example. In a county with a population of 7,000, there are about 3,000 out-of-town workers according to the Sublette County Socio-economic Analysis Advisory Committee. About one-half of these workers are in the county at any one time and they earn about $74 million a year in wages, plus overtime. It is likely that hardly any of this money is spent in Western Wyoming. BLM drilling permits for Wyoming, New Mexico, Utah, Colorado, and Montana are up 62 percent over the previous year.

The average price of a home in Sublette County in 2003 was $190,000. In 2005, the average price increased nearly 30 percent to $245,000. Nearly half of the out-of-town workers were "thinking about moving to Western Wyoming", 5 percent lived outside Sublette County in Western Wyoming, 14 percent were planning on moving to the area, but 26 percent were not even contemplating the idea. Pinedale, Sublette County Seat, has asked BLM to slow down the pace so planners can catch their breath. BLM outlook is to do the opposite.

Manufacturing Plant (Kentucky)

Population growth and the ability to have adequate community services was a key component in the decision by Toyota to locate a manufacturing facility in a rural area of Kentucky. A rapid influx of people to build the plant would be concluded with a permanent workforce without sufficient schools, hospitals, and municipal services. Toyota invested in building infrastructure in exchange for future tax benefits. Both Toyota and the rural Kentucky county benefited. Unemployment is down, and they enjoy a good tax base with infrastructure in place.

Lessons Learned

Planning for socio-economic impacts must be done and implemented before development begins to take place. In the case of private lands and single plant ownership, coal liquids, like Toyota, involves a single corporate entity who could make corporate decisions and plan with the community to invest the money needed to create the needed community infrastructure. On public lands in the west, plans will need to include multiple companies who may be competing with other developments for community services. Regional, rather than local, plans are needed to effectively mitigate the adverse effects of unconventional fuels development.

PROGRAM ELEMENTS

The socio-economics cross-cut plan is unique from the other cross-cut plans in the fact that it is contains substantial recommendations for legislative actions. The Task Force believes that the most effective way to mitigate the impacts of industry development is through changes in funding and upfront support for social projects in affected communities.

The lessons learned from previous oil shale endeavors among other industry booms have resulted in the recommendations that are presented in this plan. The objective, strategies, and key activities of the socio-economics cross-cut plan are presented in Table II-6.

The following sections of this plan will describe in detail the strategy, legislative recommendations and rationale for those actions, and the activities of the Task Force that will support the objective.

PROGRAM STRATEGY

The program strategy is comprised of three components including a strategy for addressing the socio-economic needs in the western region of the United States, a strategy for the eastern states, and a general strategy for funding community planning and infrastructure development.

Table II- 6. Socio-economics Cross-cut Plan Objectives, Strategies, and Activities

Objectives	Strategies	Key Activities
Ensure states and communities are prepared to handle the social and community impacts associated with industry development.	Support development planning, funding, and training to avoid or mitigate adverse local impacts and maximize state and local job opportunities and economic growth.	Support local planning activities
		Assess vocational training requirements
		Coordinate community funding

Western States Strategy

The vast majority of oil shale related socio-economic impacts will result from the rapid influx of workforce and permanent population growth. The total populations of the states of Colorado (~5M), Utah (~2.3M) and Wyoming (~0.5M) represent less than 3% of the U.S. population. At present no more than about 100,000 residents are distributed in the immediate three-state oil shale region. Oil shale and CTL developments would likely double the existing population. Even the first development stages will have a major impact on local communities through an influx of people.

Western communities' want unconventional fuels development to occur in an orderly fashion. This requirement entails effective planning and communication and the availability of financial resources to support these processes. Relatively small amounts will be required in the initial phases, increasing as community infrastructure is expanded by construction. A common problem for the impacted areas is that the financial needs invariably precede the project tax and royalty revenues.

Large financial benefits will flow from these developments, locally, regionally and nationally, but the timing of the revenues will not coincide with that of the costs. The question is how to bridge this timing gap in a way that results in an equitable risk/benefit relationship for both the public and private sectors. Local communities should not be expected to take upfront financial risks for developments over which they have little control.

Local communities are also concerned about being overwhelmed with an influx of people seeking jobs that have yet to materialize; so keeping expectations at a realistic level is important. This can only happen with realistic development projections, joint public/private growth planning, and effective communicating of results to the public at large.

Eastern States Strategy

CTL plants located in the eastern states will largely take place on private lands. Therefore, there will no Federal lease bonus money to use as part of the community planning and development. States and counties will have to work directly with developers.

Most of this development will likely be in rural areas. Mining workers may come from the area. A large gasification electricity and fuels plant will be a significant employer. If such a plant is sited in rural areas, significant planning will be needed. The utility company may be able to work with local communities as Toyota did in Kentucky to assure social infrastructure. This can be planned prior to construction and implemented during the construction phase of the plant.

General Strategy

Communities in both the east and west have similar issues with socio-economic impacts. Communities have formed a number of planning organizations to address these issues (see Appendix A). These organizations have indicated several objectives they seek to achieve in assessing the potential and desirability of developing a domestic oil shale industry in rural Colorado, Utah, and Wyoming. These objectives are relevant to mitigating the impacts of all unconventional fuels across the United States. The key objectives are:

- Secure revenues for planning, impact assessment, and communication with state and Federal agencies to anticipate development impacts and implement advanced plans for mitigation.
- Establish policy and promote legislation that minimizes potential economic risks to states and communities associated with industry failure or energy price volatility.

- Secure funding for timely development of necessary community infrastructure.
- Anticipate and provide for best available solutions for community health, education, environmental, economic, and quality of life concerns.
- Coordinate with industry relative to needs and support of direct work force, families, and population growth associated with project development.

Orderly and efficient development will require alignment of interests of many stakeholders. These developments will be long-term in nature and economic and community growth activities must engender the support of local populations. Community needs should be met, insofar as possible, through a consensus of private and public interests at large. Initial discussions with key constituencies, thus far, have yielded significant and valuable insights that can inform Federal planning efforts.

Socio-economic planning for rural areas to cope with increased coal production and shale oil and tar sand production will likely require state and Federal assistance. Congress could designate the USDA rural development program as a fund for these areas to facilitate planning and as a bank for needed infrastructure that could be repaid as taxes are generated. This planning and funding could include public services such as schools, hospitals, and protection.

Current funding sources for planning and infrastructure depend on regional and state agencies. Actual construction generally requires the locality to incur some kind of indebtedness combined with grants from Federal and state governments. These grants are usually received after a need is proven. Pre funding projects using this mechanism will require new thinking and confidence that the planned unconventional fuel development will proceed. Coal liquids companies could receive a tax credit for prepaying social development needs.

LEGISLATIVE RECOMMENDATIONS:

During the 1973 Prototype Oil Shale Leasing Program, Colorado dedicated a part of its lease bonus payments to a fund aimed at community infrastructure. Other sources for funding include collections for the Mineral Lease Funds (under the Mineral Leasing Act of 1920) for production of oil, gas, minerals, and other resources on Federal land. Fifty percent of these funds are distributed to the state of origin, 40 percent goes to the Federal Land and Water Conservation Fund, and 10 percent goes to the Federal General fund. Because the U.S. public at large will reap benefits from oil shale development, it may be appropriate that Mineral Lease Funds be used as a type of 'investment bank' to provide funds for costs associated with extraordinary growth. Revenues from a growing industry should be more than adequate to pay back these loans in a reasonable period of time.

Community planning and development can also be funded with Federal payments to local governments called "Payments in Lieu of Taxes" or PILT. These are funds distributed to localities to help offset losses in property taxes due to nontaxable Federal lands within their boundaries.

The Federal government currently funds 2/3 of PILT and imposes restrictions on its use. This limits local communities' abilities to fund needed projects in a timely way. Since the communities are small, bonding and borrowing are limited. Additional restrictions on funding community projects include the taxpayer bill of rights in Colorado.

The Task Force has examined the rules and regulations, including the limitations of PILT, that affect the flow of funds needed to support community development activities. These recommendations are provided below.

1. **Amend PILT** legislation PL 97-258, 31 USC Chapter 69 –

    c. Repeal Sec. 6903 (a) (1) Payment Clauses, and renumber.

    d. delete the words "reduced (but not below 0) by amounts the unit received in the prior fiscal year under a payment law" at the end of Sec. 6903 (b)(1)(A)

    Repealing this clause will have the effect of releasing Mineral lease funds to the counties. It will also help solve the soon-to-expire exemption for the forest payment issues in the Pacific Northwest.

2. **Fully fund PILT** – Current appropriations are only about 2/3 the PILT authorization. Fully funding PILT will assure that no local government is harmed by the proposed repeal of the Payment Laws, which, if not fully funded, will cause some redistribution of current funds, with winners and losers the result.

    The Payment Laws in PILT have proven to be a barrier to the flow of Mineral Lease Funds, Timber Funds, etc. to local communities. The Payment Laws were originally included in PILT under the belief that without them the Federal government would make duplicate payments on some Federal lands. However, the formula used to avoid duplicate payment is faulty. The formula should have been based on acreage, not dollars. By offsetting dollars the effect is to forgive the Federal government from paying in-lieu taxes on vast acreages just because some acreage within a county produces revenue by another means. This has created an impossible situation for local commissioners and has given states leverage to retain vast sums of Federal bonus and production royalty money at the state level that are being generated from both non-renewable and renewable resources at the local level. The Strategic Unconventional Fuels Task Force Socioeconomic Working Group endorses this proposed amendment, and believes that if the Payment Law restrictions are removed that localities will have greater leverage with states to share in the revenues. Importantly, if PILT is fully funded all local jurisdictions will benefit. It is also the proper legislative action relative to the Nation as a whole.

3. **Amend Mineral Lease Act to directly disperse Federal Mineral Lease revenues** from oil shale and tar sands to communities. To ensure communities are properly funded to mitigate socioeconomic impacts amend the Federal Mineral Lease Act to directly disperse 25% of lease revenues (from oil shale and tar sands leasing only) directly to the localities of origin, 25% to the State and 50% to the Federal government.

4. **Amend Mineral Leasing Act to provide for a royalty credit to producers** of unconventional fuels against expenditures made for socio-economic impact mitigation and community infrastructure development that may be expended prior to initiation of commercial plant operations and generation of the royalty revenue stream. Stipulations may include: a) definition of capital infrastructure as having a useful lifetime of 10 years or greater, b) formal approval by cognizant elected officials as being required for a public purpose, c) recoupable as a credit against future royalties on a dollar for dollar basis but not to exceed 50% of royalties due and payable in any given year, d) must be recouped within 12 years from actual investment, e) no alternative Federal credits for such investments shall be recognized.

    The use of private money for up-front infrastructure costs reduces the need for appropriated funds, bonding or other public financing needs. Public costs for reimbursement of approved expenses are only incurred in the event production occurs, at which time the public receives sufficient new revenues to offset the costs. By engaging the private sector in timely financing of public infrastructure needs, the public/private partnership is strengthened, and the project time-schedule is accelerated.

5. **BLM land exchanges -** Assist areas in western states that are landlocked by government land to acquire BLM land through sales or exchanges. Also, institute regulations that mandate timelines for development to prevent speculators from buying land and sitting on it.

6. **Direct resources to generate economic diversity** in regions of unconventional fuels development. It is recommended that the Department of Agriculture be directed to use a portion of their rural development funds to provide money for economic diversity in the areas targeted for unconventional fuels development.

7. **Earmark lease bonus payments for socioeconomic mitigation projects -** It is recommended that Federal lease bonus payments be placed in a "bank" to provide loans for local development and socioeconomic mitigation projects. This money is needed as development starts and before tax revenues are generated. Loans could easily be paid back as the projects generate tax revenues.

8. **Authorize future funding of education and vocational training grants** to attract and train skilled labor to meet requirements in impacted communities.

ACTIVITIES FOR MITIGATING SOCIO-ECONOMIC IMPACTS:

In addition to recommending specific legislative actions, the Task Force plans to mitigate socio-economic impacts by engaging in the following activities.

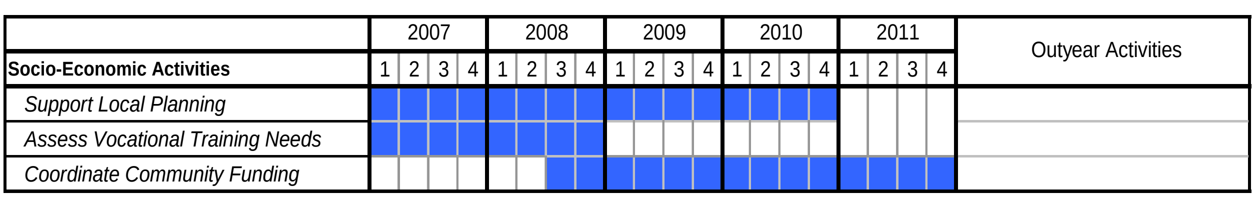
1. **Support local planning activities**: The Task Force recommends that city-specific planning be undertaken using a minimum and maximum expected development pattern over time. The capital expenditures and the cost of additional services associated with the development profiles represent the minimum and maximum dollars needed to support future growth. The program will provide 5 to 10 million dollars worth of funding support for these planning efforts as well as in-kind assistance in the form of data, analysis, and coordination support.

2. **Assess potential labor requirements** for, and availability of, skilled professionals and tradesmen to plan, construct, and operate unconventional fuels facilities. Evaluation will be used to make later recommendations on funding of vocational training.

3. **Coordinate Community Funding:** The Task Force will recommend dispersion of community funds.

A schedule for these activities is provided in Figure II-51.

Figure II- 51. Socio-Economic Impact Mitigation Activities



APPENDIX A
EXISTING COMMUNITY PLANNING ACTIVITIES

Several organizations already exist in the oil shale development region to assist in community and socio-economic planning.

Utah

Regional counties and cities have planning and zoning boards that will form a nucleus for socio-economic planning.

Uintah County has a public land board as well as a full time support staff and a contracted expert to advise them on issues involving all aspects of public lands.

The Uintah Basin Association of Governments also provides staff and assistance for economic development and planning.

The School of Business and Economic Research at the University of Utah maintains state socio-economic models (REMI model) and statistics.

Colorado

Colorado has established the Associated Governments of Northwest Colorado and the Department of Local Affairs for joint review, economic modeling, and assessment activities.

CLUB 20 is a coalition of individuals, businesses, tribes, and local governments in Colorado's 22 western counties, organized for the purpose of speaking with a single unified voice on issues of mutual concern.

In prior times a joint state/local/industry CITF (Cumulative Impacts Task Force) was established to develop computer models and assess socio-economic impacts.

Establishing a tri-state task force for these purposes may be worth considering. As program planning progresses, it may be advisable to establish additional groups and forums to better enable stakeholder engagement.

CARBON MANAGEMENT CROSS-CUT PLAN

CARBON MANAGEMENT CROSS-CUT PLAN

INTRODUCTION

An inevitable consequence of economic activity and energy production and consumption is the generation of by-products, including carbon dioxide (CO_2). Carbon dioxide is recognized as a greenhouse gas that can contribute to global climate change. Even with increased efforts to improve energy efficiency, the world economy is demanding ever-increasing quantities of energy. Global and domestic demand for crude and refined products continues to expand.

The United States Government is committed to developing a portfolio of techniques and technologies for reducing carbon dioxide emissions. Central to this strategy is reducing carbon emissions per unit of production. Technologies are being developed and demonstrated for more efficiently concentrating and capturing carbon dioxide generated in energy producing processes. Global and national assessments of carbon sequestration potential show great potential storage capacity in the United States.

The U.S. Department of Energy has formed a nationwide network of regional partnerships to help determine the best approaches for capturing and permanently storing gases that can contribute to global climate change. The partnerships are a collaborative government/industry effort tasked with determining the most suitable technologies, regulations, and infrastructure needs for carbon capture, storage and sequestration (CCS) indifferent areas of the country. Under the auspices of these partnerships, characterization studies to assess CCS potential were conducted from September 2003, through June 2005. Validation phase field tests are currently underway. The seven partnerships that comprise this network include several national laboratories, more than 300 state agencies, universities, and private companies from 40 states, three Indian Nations, and four Canadian Provinces.[45]

In April 2007, DOE announced the first edition of its Carbon Sequestration Atlas of the United States and Canada. The Atlas shows the seven regional partnerships' preliminary estimates of sequestration potential, totaling 3,500 billion tons in oil and gas reservoirs, unmineable coal seams, and deep saline formations. The estimates do not include all of the formations, nationwide, in each of these categories nor other formations, such as basalt and organic rich shales. Assessment of the other areas and formations will continue. The seven carbon sequestration partnerships have estimated over 1,000 years of total sequestration potential in the United States.[46]

The U.S. Environmental Protection Agency is also assessing the potential for carbon sioxide sequestration in geologic formations and has recently issued guidance relative to the Safe Drinking Water Act regarding use of injection wells for carbon dioxide subsurface storage and sequestration.[47]

The Battelle Global Energy Technology Strategy Program (GTSP) in 2006 concluded that "assuming that other advanced energy technologies are developed and deployed along with carbon capture and storage systems, this potential storage capacity should be more than enough to address CO_2 storage needs for at least this century."[48] The GTSP report also found that storage opportunities exist throughout the United States.

Task Force Goals: The goal of the Task Force on Strategic Unconventional Fuels is to ensure the economic growth and energy security of the United States by replacing a substantial portion of the nation's increasing imports of petroleum and petroleum products with transportation fuels produced from oil shale, coal to liquids, tar sands, heavy oil, and CO_2 enhanced oil recovery.

These unconventional fuels will require more energy to produce, and therefore are expected to generate more CO_2 per unit of output than conventional oil. However, because the unconventional fuels production processes will be largely centralized in large manufacturing facilities there is a greater opportunity to capture, concentrate and beneficially utilize CO_2. Even if by-product markets cannot be found for all the CO_2 captured, the higher concentration of CO_2 generated in these processes can be expected to reduce the cost and improve the feasibility of carbon capture and sequestration (CCS) for any excess volumes produced.

The carbon management strategy outlined in this section of the Commercialization Strategy, Plan, and Recommendations focuses on carbon capture and concentration (CCC) to mitigate added emissions of CO_2 by production of industrial grade CO_2 for sale in the marketplace or for permanent sequestration. Public acceptance of unconventional fuel products will be greatly enhanced as the program succeeds in achieving these goals.

SUBPROGRAM GOALS

The goal of the Carbon Management Plan (Plan) is to encourage and facilitate the development and adoption by industry of technologies and techniques for capturing and concentrating carbon dioxide and the development of markets or sequestration opportunities for produced carbon dioxide.

The strategy for accomplishing this goal focuses on coordination of the extensive and growing activities in the nation's existing carbon capture and sequestration programs with the unconventional fuels development program, and specifically to promote the development of technologies that address the unique characteristics of unconventional fuels processes to enable capture and concentration of industrial-grade CO_2 and facilitate its beneficial use or effective storage or sequestration.

OBJECTIVES

The major objectives of the Carbon Management Plan are to:

- Achieve and exceed emissions parity with conventional petroleum by producing concentrated streams of industrial grade CO_2 and beneficially utilizing the incremental increase in CO_2 production over that of conventional petroleum.
- Enhance industry's ability to utilize the produced CO_2 byproduct for enhanced oil recovery (EOR) and other beneficial uses.
- Develop diverse markets for industrial grade CO_2 through process technology innovation and coordination of source locations with use locations.
- Facilitate the development and operations of a domestic unconventional fuels industry by integrating the goals of technology development in coal, oil shale and tar sands with the goals of capturing, and utilizing or storing produced CO_2.
- Support and collaborate with the National Energy Technology Laboratory's Carbon Sequestration Program and the Regional Sequestration Partnerships as vehicles to assist the integration of unconventional fuels carbon management technology with the broader carbon management objectives of the nation. The NETL carbon sequestration program is a

comprehensive program that includes all aspects of sequestration including identification and assessment of opportunities, technologies, and monitoring and safety. Many of the strategic actions outlined below should be understood as support for the relevant parts of the NETL program, or as recommendations of extensions to or enhancements of the NETL sequestration program specific to the goal of carbon dioxide marketing or sequestration in production of unconventional fuels.

STRATEGIES FOR MEETING GOALS AND OBJECTIVES

Objective 1 - Promote the Capture and Concentration of Industrial Grade CO_2

Strategy 1.1 – Assess Carbon Profiles: In order to assess the potential production of industrial grade CO_2 from a domestic unconventional fuels development industry, it is necessary to examine the CO_2 profile resulting from each possible industry component including the volumes and key compositional characteristics of each resulting CO_2 stream.

Strategy 1.2 – Technology Assessment, Demonstration and Advancement: To ensure that unconventional fuels production can efficiently separate and capture carbon dioxide for marketing or storage, technology currently available and being developed must be assessed. Carbon capture and concentration process technologies available for potential unconventional fuels demonstration projects must be identified.

The plan will promote the design, engineering and development of these units and assist in the integration of these units with unconventional fuels production processes. Particular attention should be given to the potential viability of using oxygen in the combustion processes so as to yield highly concentrated CO_2. The plan should also support the utilization and scale-up today's modest commercial CCS deployments, where possible.

Strategy 1.3 – Examine Novel Concepts: The plan will provide for examining the potential for novel unconventional fuel process improvements that might further reduce CO_2 production or the cost of capturing and concentrating it.

Strategy 1.4 – Develop Technology that Results in High Purity CO_2: High purity CO_2 process streams are most desirable for beneficial use or highest value use. Development of these will be promoted in the plan.

Objective 2 - Utilize CO_2 for EOR and other Beneficial Uses

Strategy 2.1 – Assess and Facilitate EOR Markets for CO_2: It is likely that the first several unconventional fuels development projects will seek to locate near markets for the high purity carbon dioxide streams. To assist industry in identifying and assessing opportunities for marketing CO_2, the plan will integrate the carbon management effort with the CO_2 EOR segment of the program plan. This will involve performing source and utilization analysis and specifying quality of CO_2 needed and inputting this information into the development program.

Strategy 2.2 Support CO_2 EOR RD&D: The plan should include continuing work with DOE in support of research and innovation in areas of CO_2 enhanced EOR, CO_2 separation technology, reservoir engineering, injection management, and monitoring systems, to increase the performance and drive down the cost of using CO_2 in this industry, thereby expanding the market opportunities.

Strategy 2.3 Reduce Delivered Cost of CO_2: The currently projected cost of concentrating CO_2 differs significantly for the various component emission streams that would comprise a fully functional oil shale or coal-to-liquids production facility.

The cost of employing carbon capture and concentration (CCC) will be more modest for concentrated streams and more expensive for dilute CO_2 streams. Significant factors in determining the cost of employing CCC in EOR also include the distance between the CO_2 source and EOR suitable petroleum reservoirs, and the characteristics of the selected reservoir itself.

The plan will include as a first step analysis of the costs the EOR market can bear, identification of source and target locations, and determination of how an unconventional fuels industry can be integrated with these markets.

Objective 3 – Develop Diverse Markets

Strategy 3.1 – Market Characterization: The plan will include development of maps of CO_2 markets and sequestration locations and infrastructure available to reach these locations. The maps will be made available to projects for use in their siting decisions. The plan will also evaluate other key factors that might be pertinent to confirming the technical or environmental viability and acceptability of regional CO_2 storage reservoirs. A comprehensive list will be compiled showing current and possible markets, such as enhanced production of coal bed methane, inerting or moderating gases, etc., for industrial grade CO_2 and estimate their volumes.

Strategy 3.2 – Develop Siting Criteria: For industry to position facilities such that they will be better able to capture and beneficially use or store produced CO_2 the plan will determine key siting criteria for an emerging unconventional fuels production industry and will evaluate other key factors that might be pertinent to confirming the technical or environmental viability/acceptability of regional CO_2 storage reservoirs.

Strategy 3.3 – Identify CTL Siting Opportunities: Industry will seek opportunities for siting of CTL plants near their CO_2 markets because coal is more readily transported than CO_2. Because of the extent and dispersion of U.S. coal deposits, CTL plants can be built in many locations across the country -- essentially anywhere there is sufficient access to coal supplies (whether at a mine mouth or along a rail or barge line used to transport coal) to support long-term CTL operations. In fact, there are a number of plant sites currently under consideration that are located in different regions of the U.S. However, given the highly heterogeneous nature of the CO_2 markets and sequestration sites, as well as the highly variable distribution of industry and expected sources of CO_2, it is difficult to generalize potential markets or sequestration opportunities. The plan will prepare a more thorough siting assessment for a carbon capture and utilization management plan.

Strategy 3.4 – Characterize Potential Storage Locations: The Nation's candidate geologic CO_2 storage reservoirs are heterogeneously distributed across the Nation but the characteristics of these formations vary from formation to formation and even within a given formation. The plan will develop techniques and best practices for characterizing and assessing the viability of potential geologic CO_2 storage reservoirs as this may influence where unconventional fuel processing facilities are sited.

Strategy 3.5 – Support Storage Technology: Large quantities of CO_2 might be potentially stored in regional deep geologic formations. Technologies will be required to ensure the efficacy of the use of geologic storage as a means of reducing greenhouse gas emissions and will be demanded by the public to build confidence in the safety of the large scale use of geologic storage technologies. The plan will include the development and proof of such technologies, including monitoring technology, to ensure safety.

Strategy 3.6 – Assess Infrastructure Costs for CO_2 Transport to End Use Markets or Storage: The potential scale of needed CO_2 transport and storage facilities (potentially hundreds to thousands of miles of new dedicated CO_2 pipelines and thousands to tens of thousands of CO_2 injector wells) represents a significant infrastructure investment and a potential challenge in terms of siting and permitting this infrastructure. Costs for CO_2 capture that are not offset by market sales for beneficial use will result in lower investment return, and this factor will undoubtedly impact investment decisions.

Objective 4 – Integration of Technology Development Goals

Strategy 4.1 – Support On-Going and Planned Large-Scale Demonstrations of Geologic CO_2 Storage: The public-private sector FutureGen power plant and the proposed Phase III of the Regional Carbon Sequestration Partnership program both represent critical platforms needed to lay the scientific, technical and stakeholder bases for the large scale deployment of CCC technologies needed to address the emissions from an unconventional fuels program. It is particularly important that the FutureGen power plant and the Phase III of the Regional Carbon Sequestration Partnerships will focus in large measure on CO_2 storage in deep saline formations as these are likely to be the major storage formation for the large quantities of CO_2 produced by unconventional heavy hydrocarbon production facilities.

Strategy 4.2 – Develop Effective Regional Carbon Management: Plans should take into account the regional variability of market and sequestration opportunities and other key factors.

Strategy 4.3 – Risk Assessment: The plan will develop procedures to address the need for scientific and stakeholder acceptance as well as appropriate site characterization and risk assessment.

Strategy 4.4 – Develop Post Combustion Carbon Dioxide Capture Technologies: The development and deployment of advanced CO_2 capture technologies could play a significant role in reducing the cost of using CCC technologies to further decarbonize the production of transport fuels from unconventional fuels. Of particular importance would be the development of advanced and significantly less expensive "post combustion" capture systems to deal with the more dilute CO_2 streams that may be created in either the oil shale or coal to liquids cases analyzed here.

Objective 5 – Integration of Program Goals

Strategy 5.1 – Support and Integrate With Ongoing National Energy Technology Carbon Sequestration Program[49] and the Regional Sequestration Partnership Program[50]: The Plan will support and integrate with these programs and will pay particular attention to the continued development, field testing and refinement of advanced CO_2 capture systems for dilute process streams and a robust portfolio of measurement, monitoring and verification technologies for stored CO_2.

Strategy 5.2 – RD&D Needs Assessment: Hold workshops and conferences to bring together the unconventional fuels industry, CCS research community, and DOE's CCS program to discuss the needs of the unconventional fuels industries and to ensure that they are being addressed through the larger DOE CCS R&D program.

Strategy 5.3 – Development and Deployment of Low-Carbon Emissions Base Load Electricity Generation: The continued development and deployment of advanced low-carbon base load electricity plants is a key to de-carbonizing unconventional fuel production that is power-intensive. For the United States, the most likely candidates for delivering the large quantities of de-carbonized base load electricity are new nuclear power plants or advanced IGCC units that have been optimized to work with CCS systems. The plan will coordinate with and support this activity which is supported and funded through the DOE/FE/NETL Clean Coal Technology and Clean Coal Power program areas.

Strategy 5.4 – Integrated Analysis of the Energy, Economic and Emissions Factors of All Energy Sources: In order to prioritize where best to focus efforts on CCC and CCS, analysis will include the regional economics of electricity production including the cost competitiveness of nuclear power in different regions of the US. The impact of both the potential emissions from these unconventional hydrocarbon production facilities and the large demand for CO_2 storage on other industrial sectors will also need to be examined.

MAJOR ACTIVITIES

Based on the objective of holding emissions to petroleum-equivalent quantities and the challenges these objectives present for CCC and CCS technologies, the following is a set of recommended actions and needs focused on reducing the uncertainty that remains in successfully developing and implementing needed technologies.

- **Define critical carbon management components of potential unconventional fuels demonstration projects** as they are designed and implemented, in order to further the understanding and examine the feasibility of applying CCC and CCS to operating resource- and site-specific facilities.
- **Support the continued development, field testing and refinement of key CCC and CCS component technologies.** In particular advanced CO_2 capture systems for dilute process streams as well as the continued development of optimized IGCC+CCS facilities appear to be of particular significance. Given the large volumes of CO_2 potentially needing to be captured and utilized or stored, the nation will require a broad and robust portfolio of measurement, monitoring and verification technologies for stored CO_2. This points to the need for the continued development of a robust, widely deployable, and cost effective portfolio of measurement, monitoring and verification technologies for injected CO_2.
- **Continue research and innovation in key areas** of unconventional fuels process engineering, CO_2 separation technology, reservoir engineering, injection management, and monitoring systems, to increase the performance and drive down the cost of critical CCC components for this potential industry.
- For CTL plants and possibly from certain oil shale technologies, the vast majority of the produced CO_2 exits the plant in a concentrated and pressurized form, after leaving the gas treatment units. This means that capture of the incremental amount over the petroleum-equivalent is relatively cost-effective. It is in a form that requires little extra processing other than perhaps some extra compression for pipeline transport.[51]
- While there are regional CO_2 EOR market opportunities, as defined in the CO_2 EOR subplan, the potential large supply of pipeline quality CO_2 from these unconventional hydrocarbon industries, as well as potentially large quantities being created by other industries' adoption of CCC technologies, suggests that an imbalance could develop between CO_2 supply and CO_2 EOR market demand. Potential cost advantage of CO_2 produced

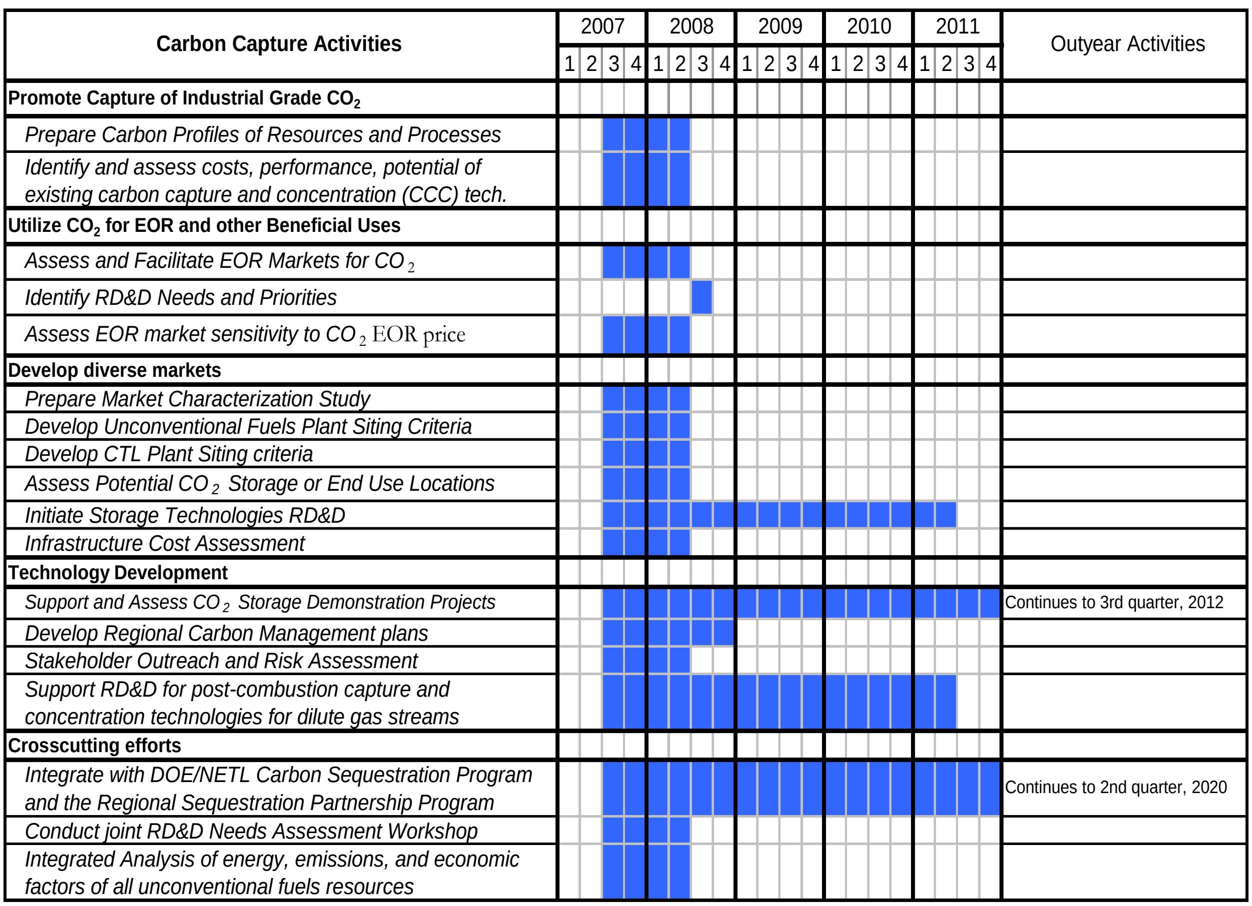
from unconventional fuels industries (compared with power generation, for example), will allow this CO_2 to better compete for available markets, and this marketing strategy will be given early attention.

CARBON MANAGEMENT PROGRAM SCHEDULE

Initial efforts to define the potential carbon emissions footprint of various unconventional fuels and assess the potential of existing capture and concentration technologies and storage approaches will be essential to development of an integrated carbon management strategy for unconventional fuels development.

Based on the findings of these analyses, RD&D needs assessments will be conducted and the priorities will be established in coordination with the managers of the resource focused subprograms and other impacted crosscutting program elements. Figure II-52 summarizes the expected schedule for development of the carbon management strategy and implementation of other subprogram activities.

Figure II- 52. Carbon Management Activities and Schedule



WATER MANAGEMENT CROSS-CUT PLAN

WATER MANAGEMENT CROSS-CUT PLAN

INTRODUCTION

The widespread full-scale exploitation of Strategic Unconventional Fuels (SUFs) represents the first major change in the oil and gas industry in several generations. In order to harvest these new resources, industry must shift to new processes and to new locations, both of which affect the amount and nature of impacts to water resources. Development of unconventional fuels will occur over a period of decades and the potential for impacts to water resources will also occur over this long schedule. Careful and thoughtful management of water issues, which occurs in a stepwise manner as industries scale up operations, will ensure protection and conservation of water. Some of the major concerns that will be addressed in the Water Management Cross-cut Plan include:

- Water impacts vary in applicability and magnitude, depending on the resource, technology applied, and location of activity.
- Current analytical tools and methodologies may be insufficient for assessing water impacts of SUF development processes and technologies, particularly in-situ processes.
- Increased demand will likely strain water supply in development areas, particularly in the west and central plains areas that are drought prone.
- Development needs to consider the needs of other water users, water rights, preservation of water quality, and other impacts of process water disposal.
- SUF development will create municipal growth and changes in community life style, leading to an increase in civil infrastructure that will increase the demand for water and generally reduce the abundance and distribution of recharge.
- Where multiple resources under development overlap, water resource and quality issues could be more complex.

The Water Management Cross-Cut Plan addresses five SUFs:

- Shale Oil
- Tar Sands
- Coal to Liquids (CTL)
- Heavy Oil
- CO_2 Enhanced Oil Recovery

CROSS-CUTTING PROGRAM GOAL

The goal of the Water Management Cross-Cut Plan (Plan) is to help industry and local communities ensure that development of unconventional fuels does not adversely affect surface or ground water quality and supply or the water rights of local water users, local governments and the affected states.

OBJECTIVES

The objectives of the Plan are as follows:

- Manage water resources to satisfy water demand and quality requirements.
- Protect rights of existing and prospective water users and meet relevant laws and regulations.
- Ensure adequacy of water infrastructure.

STRATEGIES

Each region of the United States and watersheds within regions has differences in water availability, hydrogeology, societal values, and competing uses for water. Each resource will have different water consumption requirements and re-use options. Best management practices on natural water systems will be identified and options identified for their adoption via voluntary and/or regulatory means. Current and proposed uses of water will be integrated into local/regional watershed databases and models to enable prediction of interactions of natural systems and expected water uses. A major thrust of the Plan will be the development of Regional Water Management Plans region that will include all relevant SUFs within that region.

Development of each resource type will require a set of site-specific and resource-specific activities to ensure protection of water in the area influenced by the extraction and processing operations. It is anticipated that most site-specific details will necessarily be addressed by the resource developers. However, many water management activities must be addressed at the watershed and larger scales to expedite resource development, while protecting water resources and minimizing cost. Site- and resource-specific activities will be tailored to meet the unique characteristics of each site within the framework of the regional hydrogeologic and regulatory/legal settings of the affected states. Resource Development Plans will be designed to be as water self-sufficient as possible and to limit negative impacts on water resources regionally, especially in areas where water resources are over-allocated.

The Plan will cover the development of five resource types: oil shale, coal to liquids processes, oil sands, enhanced conventional oil recovery and heavy oil. Other potential unconventional resources may be identified in the future. For each resource type, the Plan will evaluate potential practices that will help decision makers address:

- Surface water quality, rights and flows,
- Ground water quality, rights and flows,
- Water disposal, recycling and treatment,
- Variations in water demand versus seasonal and climatic variations in supply,
- Process water availability, handling and reuse,
- Water consumption, or other impacts to water, resulting from new infrastructure,
- Water used for energy generation and population growth, and
- Long-term impacts to water after site closure.

Objective 3.1 Manage water resources to satisfy water demand and quality requirements (Objectives are provided in the Appendix Table).

Strategy 3.1.1 Understand water requirements of unconventional fuels resource development

The Plan will identify hydrologic, geologic, land use, water quality, resource characterization, and other data and reports relevant for the simultaneous planning and management of unconventional fuels development, and the protection and conservation of water resources. It will be particularly important to incorporate new understandings of water impacts using recently developed technologies because much of the published information dates to the oil shortages of the 1970's. New assessments of impacts to water resources using state of the art technology in conjunction with updated hydrological data are required to accurately predict and avoid adverse impacts. Knowledge gaps and needs for additional data will be identified and prioritized. These data will be used to characterize and rank water resource issues of concern by region and by resource type.

To facilitate data analysis, communicate complex water use relationships and improve the quality information used to make decisions, relational, geo-referenced databases will be developed for regions and SUF resources. Existing and new data will be incorporated in the database. The Plan will interface with Department of Interior and Energy-Water Nexus programs and will incorporate or link to other databases and technology development activities. Relevant historical characterization data will either be specifically integrated or linked to existing data so that common data sets can be utilized. The database will be open, transparent, traceable, unbiased, and publicly accessible to all interested parties.

Communication to a wide array of stakeholders with varying backgrounds and interests is an important aspect of the strategy to understand impacts to water resources from SUF development. Computer models are well suited for integrating and simplifying complicated sets of water data. Output can be tailored to answer specific questions posed by decision makers, environmental regulators, water managers, special interest groups and others. Computer models for groundwater and surface water quantity and quality will be implemented to assess spatial and temporal water supply distribution issues and to serve as tools to maximize efficient utilization of water resources for multiple purposes. The models will help decision-makers identify obstacles (including legal and regulatory problems) to making more use of produced water (e.g. from oil and gas operations) for greater beneficial use (i.e. agricultural, industrial, development of unconventional fuels, human consumption, etc.). Relevant scales may range from local or regional watersheds to multi-basin scale models. Previously implemented calibrated models, including available documentation and input files, will be identified and incorporated in the database and new modeling efforts will be added to the database as they are undertaken. Results from field-scale demonstrations will be incorporated into the models to increase confidence in their accuracy and reliability.

Strategy 3.1.2 Employ conservation, recycling, and treatment processes and technologies to put water to greater beneficial use

Water is not generally destroyed in the extraction of unconventional hydrocarbon resources and, with careful management; utilized water can be made available for other uses. The Plan will strive to ensure that developments are "closed" hydraulic systems and only supplemented minimally by waters from outside the process (e.g., purchase of additional water rights). The Plan will identify and promote:

- Methods to maximize water re-use,
- Technologies to clean contaminated water and methods to responsibly dispose the removed contaminants,
- Regulation changes to facilitate re-introduction of treated water to natural systems,
- Incentives to manage water rights negotiations,
- Enhanced use of lower quality water for industrial processes,
- Beneficial re-use of water for other purposes,
- Process changes to reduce evaporative losses to the atmosphere.
- Cross-industry cooperative use of water (e.g. reject water from one industry used in the process of another).

Another major thrust of the Plan will be identification (and communication) of technologies needed to enhance resource development while simultaneously protecting and preserving water resources. The data management tools developed under this plan will be used to identify gaps in knowledge and identify water-related constraints to resources development. Uncertainties in water management will be estimated and methods identified to reduce decision sensitive uncertainty. Robust, high-confidence approaches to mitigate constraints and reduce costs will be identified, evaluated, and recommended.

The Plan will solicit input from industry, government agencies, and other stakeholders to identify RD&D needs to protect and preserve water. Some of these needs include, but are not limited to, 1) technologies to control contaminant leakage or leaching from the energy resource to surface or ground water during or after processing, 2) improved definition of the geochemistry of potential contaminants generated by unconventional fuel production, 3) changes to the permeability and porosity of the subsurface that may occur due to hydrocarbon extraction, and 4) the impacts to water quality and quantity. Water needs for associated infrastructure (e.g., communities and roads) will be incorporated into the analyses.

Objective 3.2. Protect rights of existing and prospective water users and meet all relevant laws and regulations

Strategy 3.2.1 Baseline and monitor water to ensure protection of quality and quantity.

State and federal agencies have collected important data on water resources for decades. The first step in this strategy is to gather this information and take advantage of existing monitoring programs that can be used to more efficiently manage water resources during development of unconventional fuels. A monitoring plan will be developed and implemented to fill data gaps and to meet regulatory needs, particularly at large scales and over long-time periods. This sort of monitoring might generally be considered outside the scope of resource developers. Short- and long-term monitoring strategies will be developed, modeled, tested, and evaluated to ensure that potential water impacts can be monitored. Existing instruments, sensors, and other systems to monitor water quality will be evaluated, additional needs identified and relevant research, development and demonstration needs will be recommended. Long-term monitoring of water systems will be initiated in collaboration with existing state and federal programs to create a baseline for early notification of unexpected performance and to avoid unintended consequences. Monitoring plans during operations and post-closure will be developed.

Characterization needed to protect water will be identified and a program implemented. This will include information on geochemistry and potential contaminants generated during and after hydrocarbon extraction is performed.

Strategy 3.2.2 Improve efficiency of regulatory process

Permitting and approval of many new resource development projects has become expensive and time consuming, adding years to when an industrial resource development can expect to receive a return on investment. Water quality and quantity are protected by a wide array of federal, state and local statues. Careful planning of the permitting process, including consolidated or parallel reviews by regulating agencies and other approaches may compress the schedule of the regulatory process while preserving the oversight needed to ensure protection of water resources. Federal and state controls and permitting of water resources will be evaluated and changes recommended streamlining the permitting process for new developments. This strategy will help reduce regulatory uncertainty and improve the efficiency of the permitting processes. Options will be identified to mitigate long-term liabilities due to unanticipated events and suggest incentives to minimize water losses and maximize water re-use.

Strategy 3.2.3 In collaboration with existing programs, enable public/private outreach for water related issues of concern

Several state and federal programs have viable programs specifically aimed enhancing communication with all stakeholders in the development of unconventional fuels. These programs will benefit from the updated and state-of-the-art assessments and models of water related impacts from unconventional fuels developed under this plan. An advantage of the cross-cut approach is that experiences gained in outreach and communication in one industry can be transferred to other SUF industries with minimal expense and effort. Output from ground water and surface water models developed under the plan can be used to communicate at the regional level an understanding of water impacts by individual developments. The Plan will enable integration of ongoing and proposed activities within industry, federal and state agencies and departments, R&D providers (universities, national labs, consultants, non-governmental organizations, etc.) and other stakeholders. In particular, it will interface with the Department of Energy's Energy-Water Nexus Program, the Department of Interior's Water for the 21st Century Program, the Bureau of Land Management's Environmental Impact Statement process, the U.S. Geological Survey's water monitoring and resource assessment programs, and other relevant activities specified in the Energy Policy Act of 2005,(primarily pertinent sections under Title III, Subtitle F, Sections 365 and 369, Subtitle G, Section 384, and Title IX, Subtitle G, Sections 977 and 979).

Objective 3.3. Ensure adequacy of water infrastructure

Strategy 3.3.1 Assess current and required infrastructure to support people, industry development and operations

An often over looked consequence of new developments is the need for more water to support more people, build new roads, new houses, new schools and so forth. These impacts are generally more extreme in rural, arid western sites and less extreme in populated, moist eastern sites. Unconventional fuels development will increase water demand due to power generation and for potable water to support population growth. Increased water demand could strain existing supply, particularly in the west. Disposal of waste water may also present challenges. The Plan will consider issues of supply and demand, needs of other water users, water rights, infrastructure for water storage and deliverability, preservation of water quality, impacts to replenishment due to roads and other community growth, and impacts of waste water disposal. These issues will vary in applicability and magnitude, depending on the resource, technologies applied, and region. Where unconventional fuel development overlaps with other resource development, water resource and quality issues could be more complex and may present opportunities to put water to greater beneficial use.

Power generation for both resource development and infrastructure requires significant quantities of water. In fact, 52 percent (USGS Circular 1268, September 29, 2006) of all surface water withdrawals in the U.S. are made for power generation purposes. As such, changes in power consumption and/or power generation may lead to greater efficiencies in water use for the development of unconventional fuels. For instance, new power generation technologies that use less water are available, but often with cost and efficiency penalties. Power conservation both in processes and infrastructure may also lead to reduced water use. The Plan will assess power requirements by region and resource and identify where improvements can be made to better manage water resources. Recommendations will be made for advancements in technology, necessary to properly support the infrastructure power needs of a new unconventional fuels industry.

This strategy will integrate the results from Objectives 3.1 and 3.2 and project water needs and its availability in the future for various planning scenarios. The results will be used to create an assessment of existing water infrastructure and to evaluate infrastructure needed to support resource developments.

MAJOR ACTIVITIES

The Plan will focus primarily on regional and national level activities to benefit a wide range of stakeholders, including but not limited to local communities and governments, Indian tribes, state and federal environmental agencies, state and federal land management agencies, energy producers and energy consumers. The Plan will address the following activities for each resource type and for each region where development of that resource is probable (Activities are identified by strategy, i.e., 3.1.2.n indicates the n^{th} activity under Strategy 3.1.2):

Near-Term (1-3 years)

<u>3.1.1.1 Identify and rank water resources issues of concern by resource and by region</u>

Collect and review hydrologic, geologic, land use, water quality, resource characterization, test results of water consumption by process, industry documents and other data and reports to create a summary by region and by resource for water issues of concerns. These issues will be ranked according to the potential for limiting resource development in a region using a numerical ranking scheme to be developed under this activity. The data and information collected in this activity will be used to develop a comprehensive relational, geo-referenced database. The results of this activity will be summarized in a report that summarizes by region of the United States the general occurrence of water resources, the potential adverse impacts from resource development and the possibility for mitigating adverse impacts.

<u>3.1.1.2 Predict potential impacts and provide recommendations to manage water resources</u>

Computer models of groundwater and surface water will be developed to 1) assess spatial and temporal water supply and quality issues 2) maximize water resource utilization, 3) ensure water protection, and communicate water related issues to a wide range of audiences. Laboratory and field tests in conjunction with modeling efforts will identify and characterize potential contaminants and fluxes during and after hydrocarbon extraction operations. Three scales may be addressed: local, watershed, and multi-basin. Quality assurance guidelines will be established to ensure consistency among new models and previously used calibrated models.

<u>3.1.2.1 Identify and recommend water conservation, recycling and treatment processes</u>

Processes and technologies that conserve, recycle or treat water to prevent or mitigate unwanted impacts on water resources will be identified and assessed for potential application to unconventional fuels development. This activity will aid industry in implementing existing technologies and develop RD&D plans to identify, promote and expedite development of emerging technologies and promote new technology development.

<u>3.2.1.1 Baseline and perform water quality and quantity monitoring</u>

Collect water data at regional or other appropriate scales integrating with the activities of private entities or other stakeholders. Develop and implement characterization and monitoring plans including Q/A procedures. Monitor surface and groundwater conditions in regional watersheds and hydrogeologic basins to provide input to predictive models and decision-making tools and to enable prompt pre-emptive corrective actions when necessary. Perform data collection, analysis and quality assurance activities, in collaboration with regional, state and federal water-resource entities

<u>3.2.2.1 Evaluate regulatory processes and find areas to make more efficient.</u>

Solicit input from industry partners and non-governmental organizations to obtain an inventory of all currently required permitting procedures and other legal processes. Provide an opportunity for these and other stakeholders to identify not only duplicative processes, but also those processes most critical in protecting the environment and serving local needs. Determine the legislative and regulatory foundation for each procedure. Identify technical solutions that are precluded by current regulations or practices. Prepare comprehensive time lines for a prototypical installation for presentation at a workshop involving representatives from all pertinent regulatory bodies to explore possible alternative and cooperative approaches.

<u>3.2.3.1 Implement public/private outreach programs and initiate collaboration with existing programs.</u>

Collaborate with local, state and federal agencies as they engage stakeholders to define water issues, regulations, jurisdiction, and policies. Use stakeholder input to produce a framework for developing appropriate water-management processes, data gathering activities, decision tools and water quality protection technology. Integrate and establish consistency with private and other stakeholder efforts.

<u>3.3.1.1 Assess current and required infrastructure to support industry development and operations.</u>

Perform an infrastructure analysis to determine opportunities to optimize water and power inputs to the resource development process, as well as minimize impacts to water and wetland resources resulting from societal and industrial changes triggered by the fuels resource development. Minimize water used for power requirements. In collaboration with the Energy-Water Nexus Program, advance technology that serves to minimize water used to meet process and community power requirements.

Activities Mid-Term (4-6 years)

All of the near-term activities will extend into the mid-term, with an emphasis shifting to analysis and recommendations based on accumulated data.

Activities Long-Term (7-12 years)

<u>3.2.1.1 Perform long-term monitoring, site closure analyses, including the development of a long-term water-resource surveillance monitoring programs.</u>

Implementation of these activities for each new unconventional fuel resource will ensure that the appropriate water-resource goals are defined prior to resource development, and that these goals are met as development takes place. This approach will identify water-resource issues up front, establish management protective measures and reduce the likelihood of costly post-development remediation efforts.

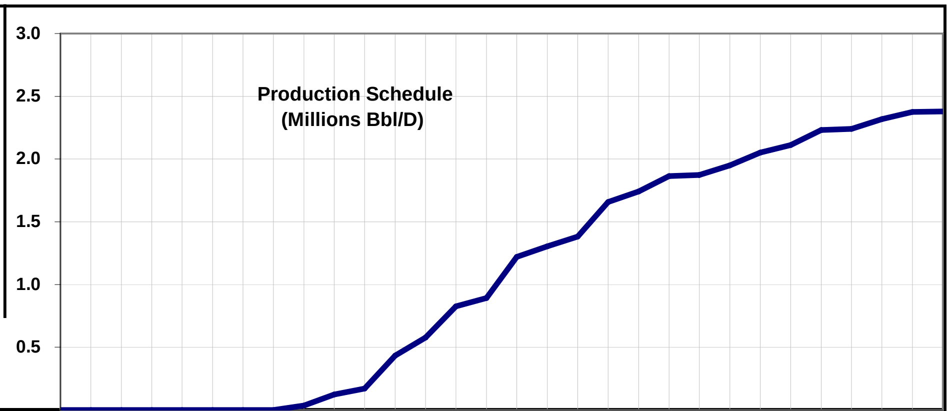
SCHEDULE

Schedules have been developed for satisfying the three objectives of the Plan as described in the preceding sections. The start date for the schedule assumes that projects are initiated during the second half of FY-07. Water management activities and schedule are presented in Figures II-53 through II-55.

Figure II- 53. Water Management Cross-Plan Objective 1, Activities and Schedule

Objective: 3.1 Manage water resources to satisfy water demand and quality requirements
Strategy:
3.1.1.Understand water requirements of unconventional fuels resources and processes
3.1.2 Employ conservation, recycling, and treatment processes and technologies to put water to greater beneficial use

Lead:



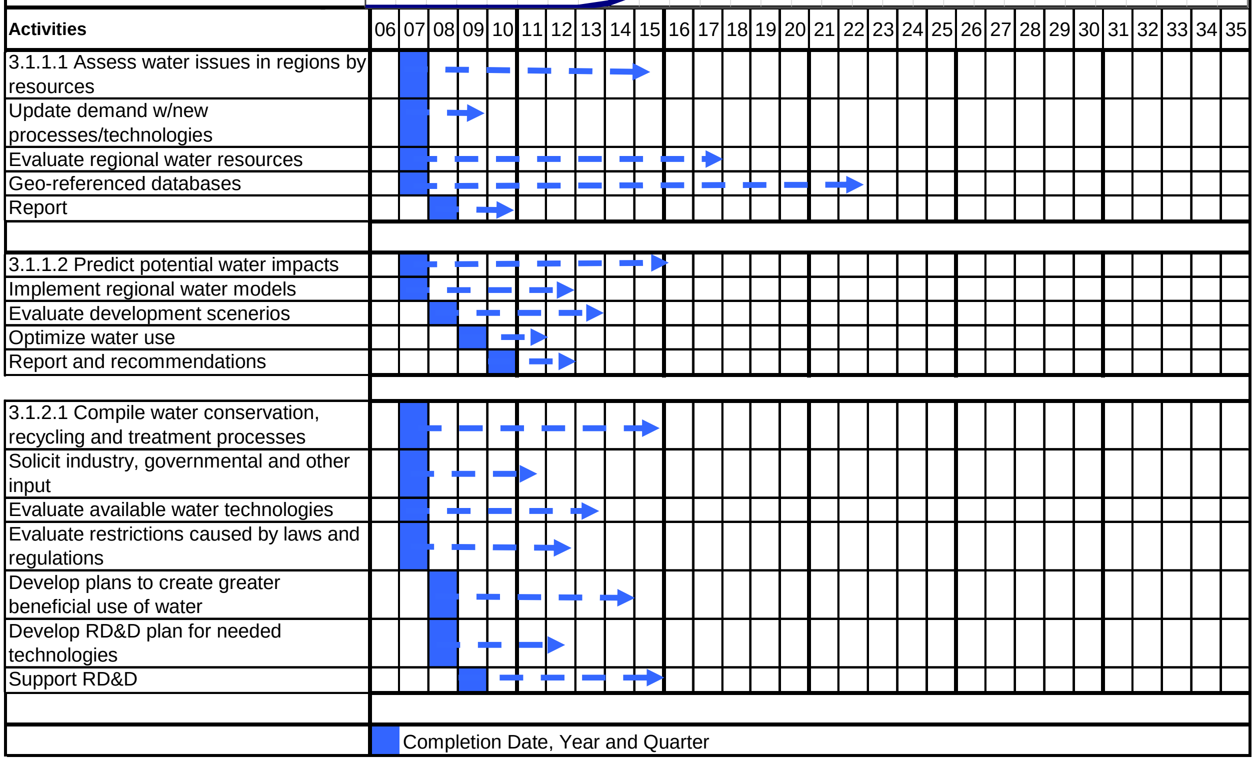


Figure II- 54. Water Management Cross-Plan Objective 2, Activities and Schedule

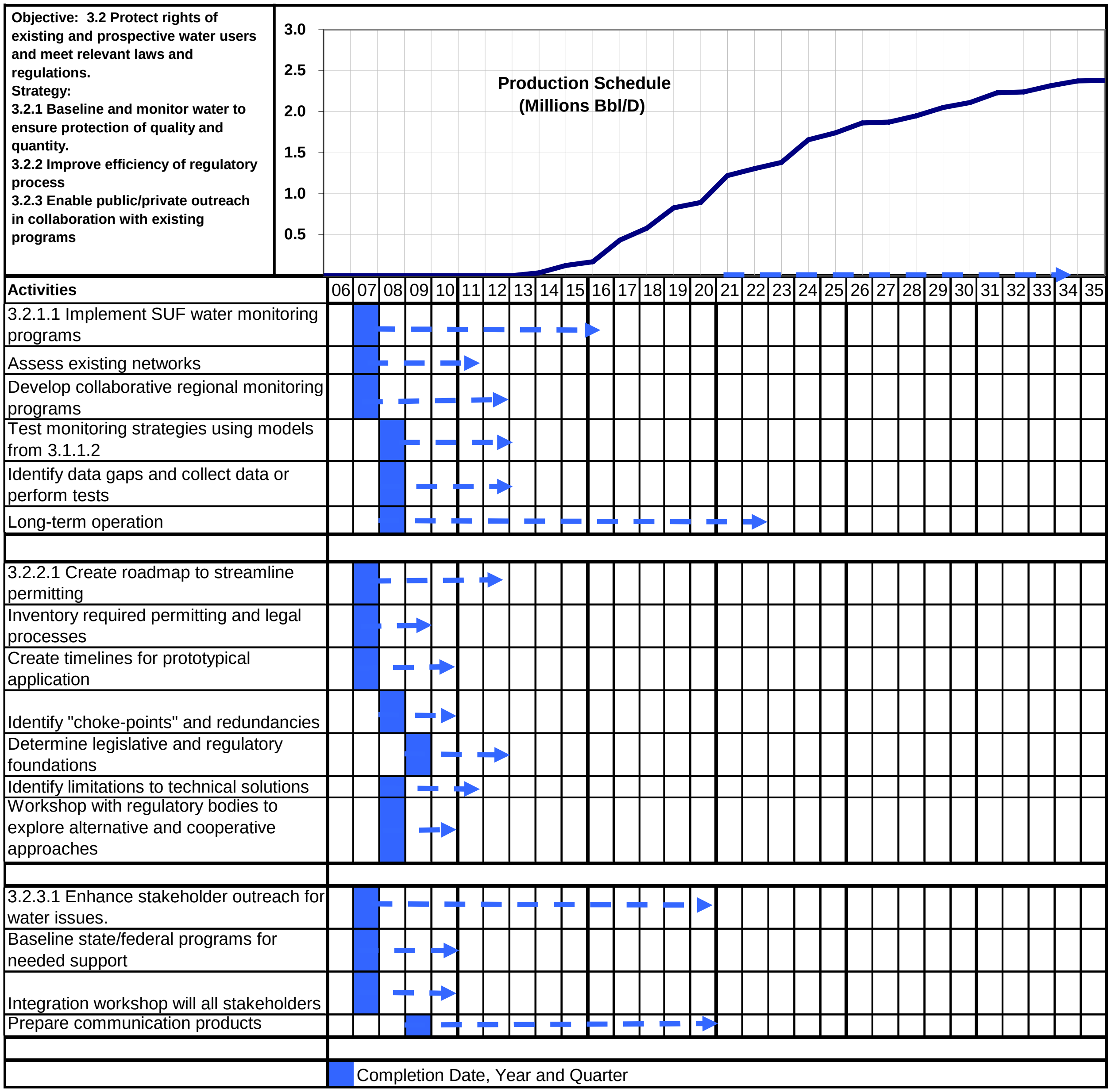


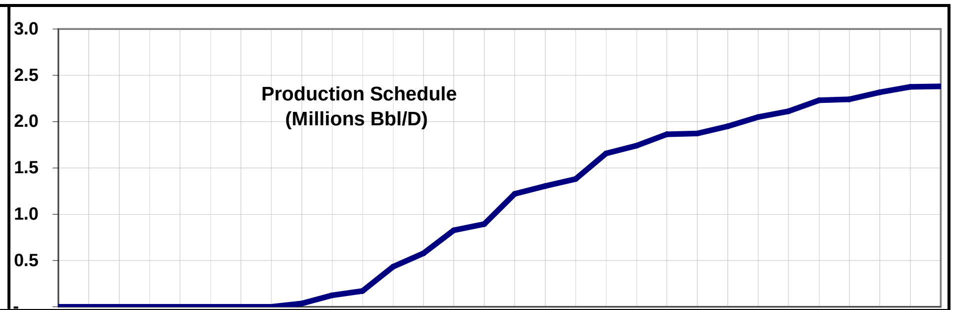
Figure II- 55. Water Management Cross-Plan Objective 3, Activities and Schedule

Objective: 3.3 Ensure adequacy of water infrastructure

Strategy: 3.3.1 Assess current and required infrastructure to support people and industry.

Lead:

Support:



Activities	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
3.3.1.1 Create water infrastructure roadmap by region																														
Assess existing water infrastructure																														
Estimate new water infrastructure needs according to a development schedule																														
Optimize planning scenerios to conserve/protect water																														
Create water infrastructure roadmap																														
Workshop results by region																														

Completion Date, Year and Quarter

APPENDIX: WATER MANAGEMENT GOALS, OBJECTIVES, STRATEGIES, AND ACTIVITIES

Subprogram goal: Address crosscutting issues that impact multiple unconventional resources
Development objectives by program element: Address crosscutting issues that impact multiple unconventional resources
Objectives
3.1 Manage water resources to satisfy water demand and quality requirements. 3.2 Protect rights of existing and prospective water users and meet relevant laws and regulations. 3.3 Ensure adequacy of water infrastructure
Strategies
3.1.1 Understand water requirements of unconventional fuels resources and processes 3.1.2 Employ conservation, recycling, and treatment processes and technologies to put water to greater beneficial use 3.2.1 Baseline and monitor water to ensure protection of quality and quantity. 3.2.2 Improve efficiency of regulatory process 3.2.3 Enable public/private outreach in collaboration with existing programs 3.3.1 Assess current and required infrastructure to support people, industry development and operations
Key Activities
3.1.1.1 Identify and rank water resources issues of concern by resource and by region 3.1.1.2 Predict potential impacts and provide recommendations to manage water resources 3.1.2.1 Identify and recommend water conservation, recycling and treatment processes 3.2.1.1 Baseline and perform water quality and quantity monitoring 3.2.2.1 Evaluate regulatory processes and find areas to make more efficient. 3.2.3.1 In collaboration with existing programs, enhance public/private outreach for water related issues of concern. 3.3.1.1 Assess current and required water infrastructure.

ENVIRONMENTAL OUTREACH CROSS-CUT PLAN

ENVIRONMENTAL OUTREACH CROSS-CUT PLAN

Effective environmental outreach informs and engages the public on the environmental impacts that may arise from planned development activities. By providing a common-sense, balanced view of the issues at hand, a successful environmental outreach effort will help determine how we can provide for the nation's future energy needs from unconventional sources while maintaining and protecting our nation's environmental and natural heritage. As reflected in our environmental laws, Americans place a great importance on preserving our natural resources and have become increasingly committed to leaving a vibrant environmental legacy to future generations. At the same time, the nation needs to develop new energy resources to sustain economic growth, reduce imports from unreliable sources and replace dwindling conventional supplies.

While much environmental progress has been accomplished in the 40 years since most of the nation's environmental laws were adopted, we continue to face complex and urgent environmental challenges driven by rapid growth. For example, in 2000 the EPA reported to Congress that 40 percent of streams, 45 percent of lakes, and 50 percent of estuaries were not clean enough to support uses such as swimming or fishing. Addressing these challenges has often been hampered by unproductive legal and political fights.

More recently, important progress been made through collaborative and innovative approaches to resolving environmental conflicts. The examples of these efforts range from the Oregon Plan for Salmon and Watersheds, to the High Plains Partnership, to Arizona's Las Ciengas Conservation Area, to the off shore oil development plan for the Bering Sea of Alaska. A key lesson from previous outreach efforts is the importance of "getting upstream" from the final decision making to iron out as many problems as possible, develop trust with key public and private leaders, and achieve public support for the development project by communicating the responsible approaches that both the oversight agencies and the developer will use to address environmental issues.

Developing unconventional energy resources at a viable commercial scale will require a significant effort to overcome technology constraints and economic and environmental barriers. Effective environmental outreach will be a critical component in addressing these constraints and developing the appropriate public policy options at the national, state, and local levels. Obviously, applicable environmental laws will have to be met. The real debate emerging in energy development today is determining and implementing appropriate level of ecosystem management. This includes best practices on-site and possible mitigation off-site to maintain critical ecosystems and ecological services affected by the development activities. The environmental outreach strategy outlined here is intended to help identify and implement management and mitigation strategies that are legal, generally acceptable and cost effective.

The technologies and development processes for each of the unconventional fuels differ greatly from one another. The necessary infrastructure, geographic regions affected, and the associated environmental impacts also vary according to the energy source and individual development plan. Although some stakeholder interests may be common to all unconventional fuels, most groups will vary according to the region involved in development and the environmental impacts.

Objective: Establish a meaningful dialogue among the various stakeholder groups regarding the environmental impacts associated with unconventional fuels development and the public policy process required to address these issues.

The outcomes are anticipated to include:

- Increased dialogue on the viability of unconventional energy resources
- Increased awareness of issues and how unconventional resources may or may not fit into the nation's larger energy picture
- Increased communication and cooperation between stakeholder groups
- Increased visibility of the benefits and costs of unconventional energy resources
- Overview of environmental issues and prospects for continued dialogue and networking to address collaborative solutions and mitigation of impacts
- Stakeholder input to the public policy development process

Rationale for Action: Congress, under the Energy Policy Act of 2005, directed the Department of Interior (DOI) to prepare a Programmatic Environmental Impact Statement (PEIS) for commercial leasing of oil shale and tar sands. The PEIS will analyze and document the environmental, social, and economic issues associated with alternative development approaches. Although EIS processes have become more collaborative over time they remain primarily a comment and review process, and will not necessarily resolve issues and identify and develop joint solutions or mitigation strategies without a carefully developed environmental outreach program. The program proposed here will attempt to address those issues before, during and after formal processes.

The benefits of an effective outreach program go beyond the goodwill generated by courteously considering stakeholder interests and may include the identification of higher quality solutions to environmental impacts and the broad acceptance of development plans which can foreclose or diminish the effectiveness of diehard opponents. By working together, differing interests can change the dynamic of a situation from one of assigning blame or searching for errors in the decision process to a common search for solutions. The parties included often gain a sense of ownership in the solution or process which can enhance acceptance of solutions and the willingness to implement them in other interests.

The risks of not involving stakeholders effectively include project delays, political and legal challenges, and the costs and time associated with these delays and challenges. Perhaps even more importantly, there is potential for widespread misinformation and the loss of general public support.

ENVIRONMENTAL ISSUES - NATIONAL, REGIONAL, AND LOCAL

A number of environmental issues have already been identified by the environmental community and other stakeholders as being important. These issues were identified in the scoping comments submitted to BLM in January 2006 by over 80 environmental/conservation organizations, government agencies, and other stakeholders. Many of these issues will be addressed in the PEIS for oil shale/tar sands leasing. There may be somewhat different issues involved in other unconventional fuel resource development in other parts of the country with the intent of supplementing those processes.

Each of these issues should also be addressed in some fashion in the outreach program. Of course there are numerous opportunities for better understanding of these issues and for addressing, discussing, and mitigation. They are discussed here to provide a better understanding of the issues that have thus far been identified as being concerns to the environmental community and to other stakeholders. These issues include:

National Energy Policy: Conservation, Alternatives and New Power Generation

Oil shale and other unconventional fuels technologies, whether they are surface retort operations or in-situ methods, require substantial energy to produce oil. For example, an oil shale retort operation producing 100,000 barrels of oil per day may require substantial amounts of dedicated electric generating capacity—essentially its own coal-fired power plant. Many environmental organizations are concerned about the energy produced to energy consumed, resultant impacts and emissions of greenhouse gases and other air pollution, and the energy efficiency of each technology.

Also, some organizations believe the development of unconventional fuels instead of cleaner energy sources would reduce the incentive or the pressure to develop these cleaner energy sources. Providing a more comprehensive view of how unconventional fuels fit into DOE's overall energy program may provide a better understanding of these issues.

Water Resources

Water is a scarce resource in the West and it is becoming more valuable as communities grow and drought lingers. There is concern about how development of unconventional fuels will impact surface water and groundwater. These are some of the largest potential issues that have been raised to date. Stakeholders are concerned with surface and ground water flow patterns, ground water infiltration, in stream flows, wetlands, and water surface runoff rates. In addition, stakeholders are also concerned with potential impacts to water quality, municipal wastewater from growing communities, as well as downstream water rights.

Air Quality/Global Warming

Most of the candidate areas for unconventional fuels in Colorado and Utah currently enjoy high quality air and are classified as Class II areas under the provisions of the Clean Air Act for Prevention of Significant Deterioration (PSD). For Class II areas only moderate increases in ambient air pollutant levels are allowed. Moreover, several areas within close range of the Piceance and Uinta Basins enjoy even more stringent protection as Class I areas under the PSD program, such as Flat Tops Wilderness Area (50 miles downwind of the Piceance). For these reasons many environmental organizations are concerned about the potential production of direct emissions of several pollutants for which National Ambient Air Quality Standards (NAAQS) have been established—sulfur dioxide (SO_2), particulates, carbon monoxide (CO), ozone (O_3), lead, and nitrogen oxides (NO_x), as well as various non-criteria pollutants on the list. These organizations are also concerned about the potential for acid rain. Several organizations expressed concerns that greenhouse gas emissions—particularly CO_2—would be increased with the additional power generation and with surface retort activity, adding to concerns of global warming.

Wildlife and Vegetation

As with other extractive endeavors on public lands, unconventional fuels development activities may create impact on wildlife and plant populations due to the presence of significant wildlife in the region. Eastern Utah, western Colorado, and southwestern Wyoming are home to many large mammals such as pronghorn antelope, mule deer, and elk. There are also bighorn sheep, moose, mountain lions, and black bears in some of these areas. Wild horses and burros are also present, and impact on these species is also of concern.

Environmental organizations and wildlife organizations are concerned with winter range for large mammals, potential loss of critical habitats, fragmentation of habitats, impacts on migration routes, and in-stream flows for fish populations. These organizations are concerned with the direct surface disturbance associated with mining activities and facilities, and infrastructure associated with development, including roads, transmission lines, pipelines, housing facilities, and areas for disposal of residuals from retorting oil shale and tar sands.

There is also concern that vegetation could be removed from large areas perhaps requiring long recovery periods. Other issues might be erosion or compacting of soil and the spread of noxious weeds.

LAND USE/COMMUNITY IMPACTS

Of vital concern to stakeholder groups, their members, and residents of the oil shale region is the potential for significant impacts to communities from the onset of a new industry like oil shale or tar sands. Significant study of the potential socioeconomic effects was undertaken in the 1970s and 1980s, much of which is now outdated. These industries are potentially labor intensive, which would bring significant numbers of new residents to the region and require accommodation in the local communities and infrastructure. The landscape in which oil shale or tar sands may be found is largely wide open and comprised of multiple-use federal lands, and is used extensively for grazing and agriculture, oil and gas drilling, hunting, fishing, and other recreational uses. The communities in the area are small and rural. Therefore, many organizations and government entities are concerned about potential impacts to these communities along with their costs, as well as the relative balance of public and private revenue to assist with their mitigation.

Waste Products — Spent Shale, etc.

Surface mining and retorting of oil shale or development of tar sands resources could result in significant amounts of spent products. Moreover, crushing and retorting may increase the volume of the waste product compared with the raw rock prior to mining. For this reason, many environmental organizations are concerned with changes to the landscape. Therefore, waste disposal methods of the waste material expected from each of the different development technologies are important. Although in-situ retorting will no doubt be less disruptive than surface mining, these issues are also of interest.

Wilderness Protection/Special Areas of Concern

Oil shale and tar sands resources lay among some of our country's most undeveloped landscapes. Several environmental organizations believe these lands have wilderness values that should be protected from development. They believe the development of this industry would create irreparable impacts to these wilderness values.

There are also concerns by many organizations that Areas of Critical Environmental Concerns (ACECs)—recreation areas, historic trails, and wild and scenic rivers—could be impacted by unconventional fuels development. The identification of these areas of concern and how to address these issues are important to the outreach effort.

Scenic/Visual Resources

Because much of the West, where unconventional fuels lie, is presently largely open, many organizations are concerned with the impact to visual resources that form the character of the landscape as seen from various view sheds. Many organizations want to preserve natural landscapes, while they recognize the normal patterns of growth—

roads, pipelines, etc.—will always impact views and vistas.

Cultural Resources

The areas of Colorado, Wyoming, and Utah, where oil shale and tar sands leasing may take place, include some of the highest concentrations of cultural resources in the nation. Oil shale or tar sands may include surface disturbances over large areas. Therefore, many organizations are concerned about the impacts on cultural resources from facilities and associated infrastructure, as well as the indirect impacts to such resources from population increases and expansion of the transportation infrastructure.

PARTICIPANTS

In an outreach program, it is important to identify important interests and ensure that participants are representative of those interests and not simply themselves. Given that large numbers of people and organizations are concerned about these issues, participant groups would need to represent these broader interests to ensure a successful outreach program. The representatives can be identified from the following interests and organizations (this list is representative and not inclusive):

National Environmental Organizations

Environmental organizations are all unique, and it should be recognized that attempts to categorize them is in no way fully descriptive of the breadth of activities in which these organizations engage. With that caveat in mind, at the national level, there are numerous environmental groups that are active in energy issues. These organizations are interested in environmental law, in protecting public health, and in protecting undeveloped landscapes. These organizations deploy various legal means in order to achieve their goals. The majority of national environmental groups thrive on large memberships, and often have a national professional staff based in one or more major cities, as well as individual chapters around the country. Information on specific environmental issues of concern is broadcast to members, and members also raise local issues with the national office that can rise to national importance. As a result of their large memberships, these organizations are well-funded and often exert significant influence and political pressure by lobbying state governors, members of Congress, and the administration. Examples of these organizations interested in unconventional fuels include the Sierra Club, the Natural Resources Defense Council, and the Wilderness Society

Regional Environmental Organizations

At the state or regional level, many environmental groups focus on more near-term concerns than perhaps national long-term policy issues. For example, in several states, local environmental groups are concerned with a single issue such as wilderness preservation and do not always have the resources to be involved in all issues. In general, it seems that many state-based environmental groups are interested in learning more and in being actively involved in research projects going on in their regions.

The other important issue to consider, however, is that it is apparent that national and regional environmental organizations are already forming coalitions and working arrangements to work together on these energy development issues, and as the outreach program moves forward this should be recognized and dealt with accordingly. Examples of some of these state/regional organizations include The Colorado Environmental Coalition, Environment Colorado, Wyoming Outdoor Council, and the Southern Utah Wilderness Alliance.

Local Environmental Organizations

These types of organizations may be located in smaller parts of the region and are focused on particular issues of concern for that area. They will likely have a great deal of knowledge about local landscapes and resources, but they are small and do not have substantial staff resources. They are also effective, as noted above, in working with other environmental organizations. Examples of these organizations might be the San Juan Citizens Alliance, the Grand Valley Citizens Alliance, and the Southern Rockies Ecosystem Project.

Energy-Based Environmental Organizations

By and large, most organizations working on energy issues are focused on promoting clean and sustainable sources of energy. In most cases, these energy-based organizations may work closely with other environmental organizations. The major example of this type of organization concerned with unconventional fuels in the West is Western Resource Advocates.

Land Conservation Organizations

Many nonprofit organizations are involved primarily in land conservation. Frequently focusing on this policy issue, they may also raise funds to purchase sensitive tracts of land and place conservation easements upon them. Sometimes the lands are then transferred to government or other organizations that manage the lands. These groups would likely be concerned with energy development projects in areas they are trying to conserve. As project sites are considered, it is important to also consider their proximity to sensitive lands in which conservation groups may have an interest. These organizations are helpful in developing mitigation strategies and in helping consensus-building and collaborative efforts. Examples of these types of organizations include The Nature Conservancy, the American Farmland Trust, the Trust for Public Land, the Colorado Cattlemen's Land Trust, Utah Open Lands Conservation Association, and other local land trusts.

Federal Government Agencies

Obviously, numerous federal government organizations play a key role in addressing, regulating, and mitigating environmental concerns related to energy development. These organizations should play a role in the outreach program. Beside the agencies involved in the task force, other agencies include the EPA, the Fish and Wildlife Service, the Army Corps of Engineers, the US Forest Service, and others.

State and Local Government Agencies

Elected officials care deeply about issues affecting the economy, public safety, and the environment. The development of unconventional fuels affects all three areas. State governments and many counties also have a department of environmental quality or departments of health, departments of transportation, and these entities should be involved in the outreach effort. Also, special districts that provide water and other infrastructure are important. There are also state wildlife agencies that have responsibility for managing wildlife in the impacted areas and will have concerns about impact to wildlife habitat. All of these entities have credibility with a variety of stakeholders and can have a huge impact on framing the topics. In addition to state and local officials, there is also benefit from addressing associations such as the National Governors Association, the Western Governors Association, the Conference of Mayors, the Environmental Council of States, etc.

Industry Representatives/Business Leaders

Other constituencies who address environmental issues are business and industry leaders and groups. It is important to understand the different perspectives that business leaders will bring to this effort which are likely to have a strong impact on public perceptions of unconventional fuels at the local level. The representatives may be from individual companies or they may represent industry or trade organizations such as the regional oil and gas associations. Also, local businesses and Chamber of Commerce organizations are important constituencies to be involved. An important resource in this category is the Western Business Roundtable.

University/Research Organizations

Many university groups have done substantial research on environmental impacts of unconventional fuels. These universities should be included in any substantial outreach efforts. The universities in the West in the impacted region might include the University of Utah, University Of Wyoming, Colorado School of Mines, Utah State University, Colorado State University, etc. Numerous other universities and research laboratories may also need to be included.

Ranchers and Other Agricultural Interests

Ranchers, farmers and those with agricultural interests will be concerned about potential environmental impacts. There are many large farms and ranches that are contiguous to federal land where unconventional fuels development might occur. In other cases, some ranches are totally surrounded by federal or state lands. It is important to engage them early on regarding efforts to mitigate impacts. Many times these interests can be represented by Farm Bureaus, Cattlemen Associations, etc. These organizations often have valuable resources and information available. Examples of these types of organizations include the Utah Farm Bureau, Colorado Cattlemen's Association, and the Rock Springs Grazing Association.

Recreation Interests

Much of the undeveloped country in the West is home to numerous recreational activities that could be impacted. The issues vary and the organizations involved also differ considerably. Some of the organizations that need to be involved in this category include the National Outdoor Leadership School, mountain bike associations, off road vehicle associations, hiking groups, canoe and rafting groups, and horseback riding organizations.

Wildlife Organizations

Wildlife organizations are advocates for wildlife habitat and many times provide access to private and public land for hunting. They may raise money to purchase habitat for wildlife. They will be concerned about projects that affect wildlife habitat or hunting opportunities. These organizations are often willing to discuss mitigation measures both on-site and off-site. Examples of these organizations include the National Wildlife Federation, Rocky Mountain Elk Foundation, Mule Deer Foundation, Sportsmen for Fish and Wildlife, Trout Unlimited, etc.

Native American Representatives

There are some Native American tribal lands that are adjacent to land where unconventional resources are found. All of these outreach discussions should include representatives from Native American tribes including the Ute tribe in Utah and other identified Native American interests.

The General Public

The main focus of the outreach program has been to create a meaningful dialogue among the various stakeholder groups regarding the environmental impacts associated with unconventional fuels development. There will be, however, a number or private citizens who are not members of any stakeholder group that may have concerns and interests in the issues. Also, general public opinion is important to development process.

A major general public involvement process is not being recommended at this juncture, but rather a process driven by stakeholder groups. However, many of the recommended action items will have major general public benefits. Many of the workshops and conferences can be attended by the general public where important information is presented. Materials will be developed along the way that will be useful in formulating a balanced view of unconventional fuels resources that is instrumental in forming general public opinion.

RESEARCH AND RELATED PROJECTS IN ENVIRONMENTAL OUTREACH

A current review of reports and plans for environmental outreach reveal generally two types of efforts. Most of the outreach projects that were reviewed were developed by government agencies or their consultants in an effort to raise awareness and educate or inform the general public about some proposed policy or action. In these cases, emphasis is placed on developing education materials that describe the proposed action and in conducting public meetings to present the information and receive feedback. The second approach to outreach focuses more on identifying key stakeholder groups and in designing a collaborative process in which there is a more collective sense of consensus building and broader impact on the decision-making process. It is the second approach that is the basis for the proposed outreach strategy for the Unconventional Fuels Task Force.

Although the approach or philosophy of outreach may differ among projects, the stated overall objectives are usually quite similar. The reviewed outreach plans listed objectives such as: gain information and feedback from constituents[52]; maintain the public trust[53]; communicate complete, accurate, understandable, and timely information to the public[54]; convey to people in the region that the project has far-reaching effects…and supports the agencies and public in working openly and collaboratively toward a recommendation that can be effectively implemented[55]; and increase awareness, understanding, and public acceptance[56].

The identified participants in the various outreach plans included public agencies, public officials, local schools, business organizations, environmental and other NGOs, tribes, farmers and ranchers, and the general public. The identification of relevant audiences or stakeholder groups varies from project to project, but is based upon an understanding of which groups are necessary to achieve the project goals. If the goal is to gain or maintain the public trust, then clearly the public must be involved. If the goal is to minimize project delays due to litigation, then those stakeholder groups who are most likely to litigate over specific issues or decisions must be engaged.

The outreach plans that were reviewed included a variety of outreach activities in order to reach their intended audiences or stakeholders. All outreach efforts include some type of forums to gather people and gain input or feedback on identified issues or proposed actions. These forums include workshops, roundtables, conferences, open houses, educational forums, and public hearings. Some outreach efforts include the establishment of advisory boards or committees where ongoing involvement is important to establish and maintain relationships with the broader community[57]. Most efforts include the development of educational materials in the form of fact sheets, project overviews, brochures, or written descriptions of the outreach plan. A number of the plans included use of the Internet as a stakeholder list-serve or electronic mailing list to send messages and provide general information or as a dedicated website for anyone that can access the Internet.

In addition to the outreach plans and projects reviewed, both CRM and the Oquirrh Institute have been involved in and conducted related outreach activities concerning energy development and other natural resource issues. For example, CRM organized and facilitated an outreach project concerning development of offshore oil and gas resources that included the oil industry, environmental groups, native groups, and government agencies. This project included a number of stakeholder conferences, workshops, and issue negotiations. The effort included the establishment of advisory committees, consensus recommendations to the Department of Interior, and a consensus plan for the development and conservation of the Bering Sea of Alaska. The formulation of the outreach plan was based on knowledge of the issues, the establishment of clear goals and expectations, extensive interaction with all relevant stakeholders, and an open and transparent process.

The Oquirrh Institute included a number of case studies of effective outreach and collaboration in their 2004 publication *The Enlibra Toolkit: Principles and Tools for Environmental Management*. The report describes projects such as the Sonita Valley Planning Partnership that undertook an outreach and collaborative process leading to the establishment of the Las Cienegas National Conservation Area. The stakeholder outreach and collaboration process included representation from conservation organizations, grazing and mining interests, federal, state, and local government agencies, as well as residents from southwestern Arizona. The Toolkit outlines important principles for successfully organizing stakeholder outreach and collaboration processes[58].

OUTREACH EFFORTS AND DEVELOPMENT ON PUBLIC LANDS

The development of unconventional fuels such as oil shale or coal to liquids on public lands will be subject to NEPA requirements and the associated public involvement activities in the course of preparing the necessary Environmental Impact Statements (EIS), Resource Management Plans (RMP) or required permits. Environmental outreach activities as recommended in this plan would not take the place of these regulatory requirements for public outreach and involvement. The outreach activities described here would be voluntary and would occur in addition to those required by federal or state regulations. This voluntary outreach would include greater stakeholder participation earlier in the process and would emphasize consensus building and maintaining stakeholder relationships. We recognize the importance of the legal permitting process and public engagement requirements and support the need for adequate funding for federal agencies to carry out their responsibilities.

A recent study of current oil and gas development in the West by several national conservation organizations points out the need for early stakeholder involvement and outreach to deal with environmental issues and the need to adequately fund federal agencies responsible for data collection, analysis, and permitting activities[59].

PROCESS OF OUTREACH AND COLLABORATION

An effective outreach and collaboration process will provide advice, analysis, and guidance from environmental stakeholders to more effectively avoid or mitigate environmental impacts associated with the development of unconventional fuels. The basic organizational structure and process of outreach and collaboration can be defined at this point in time, but it is understood that participant stakeholders must be involved in the design process to insure the activities and outcomes are accepted and supported. Participant involvement in process design will result in changes to the process as well as higher levels of commitment and ownership.

The process for environmental outreach and collaboration involves a number of activities beginning in the early stages of energy development planning and continues through construction and operation phases of individual projects. In order for the process to be effective as a means of guiding development, the necessary information and stakeholder activities must have both organization and focus. In the case of oil shale development, an entirely new industry with the necessary support infrastructure must be created in a very rural environment. The amount of research and information needs will be significant and all stakeholders who participate in the process will benefit from an organized and focused structure that facilitates data collection, analysis, and dialogue. The key components of the process will include the following:

Phase I – Assessment

- Develop outreach materials
- Identify key issues, interests, and stakeholder groups
- Define core stakeholder participants
- Define agenda, timeline, and resource needs

Phase II – Organization, Process Design

- Organize advisory committee and sub groups
- Define objectives, roles and expectations, principles and procedures
- Define outreach activities
- Identify information needs

Phase III – Convene Substantive Discussions

- Plan and organize regional conferences/workshops
- Review development plans and analyze issues
- Identify areas of agreement and points of conflict
- Identify data gaps and input to research agenda
- Build consensus on environmental guiding principles
- Provide input and guidance on environmental management plans

Phase IV – Monitoring, Ongoing Assessment and Feedback

- Monitor development activities and environmental impacts
- Maintain ongoing forums and organization for stakeholder dialogue
- Provide continued assessment and feedback of development activities and environmental mitigation needs

GUIDING PRINCIPLES FOR SUCCESSFUL OUTREACH AND COLLABORATION

Voluntary collaborative processes as a means of consensus-building and collective problem-solving require a much different approach than what typically takes place as the result of regulatory proceedings involving public hearings, formal comment periods, or other prescribed public involvement activities. Collaborative outreach focuses on common solutions and mutual trust of all stakeholders. Some guiding principles for successful outreach process using this approach include the following:

- Identify and elevate the common good
- Process should be inclusive, transparent, and flexible
- Encourage openness, information exchange, and cooperative learning
- Foster understanding of interests and perceived risks of all parties
- Process requires adequate resources, time, and skillful and objective facilitators

Tools for outreach and collaboration: As meetings are conducted and workshops and conferences convened, there are a number of technology tools available to help groups move toward consensus. Each of these tools can be applied in the appropriate setting as cost allow. These tools include:

- Sketch scenarios with digital chip analysis – a method of constructing hypothetical development scenarios and look at impacts.
- GIS maps and animations. Tools available to understand the magnitudes of impacts and how to visualize them.
- Keypad polling – a method of determining the degree of on-going consensus of a group before discussion, during discussion, and at the end.

Outreach Activities and Materials: The outreach program will have four primary activities:

1. Establishing an organizational structure of stakeholder committees
2. Organizing and conducting regional workshops and conferences
3. Developing outreach materials and Internet resources
4. Monitoring, evaluation, and program management

Within these primary activities are a number of specific actions and materials as described below:

1. Establishing an organizational structure of stakeholder committees.

Within each fuel source and affected region of the country are various types of stakeholder groups that can influence public policy and public opinion. These groups need to be engaged early in the resource development process to gain their input and support as a means to improve decision-making and mitigate environmental impacts. Regional subcommittees for each fuel source should be established under the umbrella of an environmental advisory committee for unconventional fuels. The advisory committee can assist in the organization of regional steering committees and play an important coordination role. Once in place, the committees can provide input to task force plans as they are developed. This will include environmental management plans and R&D plans for oil shale, tar sands, heavy oil, enhanced oil recovery, and coal to liquids. The committees should also be empowered to develop a declaration of guiding environmental principles for each fuel source. This will provide a basic foundation for stakeholder input and a guide for consensus building on specific environmental issues. The committees can also be a resource to develop any off-site mitigation projects that may be necessary as part of an overall environmental management plan for a given fuel resource. For example, a mature oil shale industry with the necessary infrastructure of roads, pipelines, power production facilities, mining operations, and in-situ wells may require off-site mitigation strategies for wildlife habitat or other resources.

2. Organizing and conducting regional workshops and conferences.

Stakeholder forums are necessary at regional levels to explain development proposals and to discuss potential environmental impacts as they affect specific sites and regions. Whether in small workshops or in larger conferences the participants can focus on the issues they are most concerned about and provide input on the appropriate mitigation strategies. A regional conference for oil shale and tar sands is being planned in the spring of 2007 following release of the PEIS. This conference would include stakeholders from Colorado, Utah, and Wyoming. The participants would review results of the PEIS and discuss the potential impacts of development from surface mining and retorting and in-situ projects. Environmental issues include potential impacts on air quality and wilderness areas, water resources, wildlife habitat, and endangered species.

Similar workshops or conferences would take place in areas affected by coal to liquids development and heavy oil and enhanced oil recovery. For example, workshops on CO_2-enhanced oil recovery projects might take place near the production basins in California, Alaska, or the Gulf Coast. Environmental issues would include potential impacts on ground water, release of CO_2 into the atmosphere, and other stakeholder concerns.

3. Developing outreach materials and Internet resources.

In addition to organized committees and regional conferences and workshops, effort should be made to reach stakeholders and the general public through accurate and balanced educational materials. Unfortunately, many environmental conflicts and controversies get started due to misinformation or information that is outdated or misinterpreted. This may be the case in oil shale development where existing information about mining and retort technologies is based on plans and projection of impacts from the industry boom and bust in Colorado and Utah in the 1970s and 1980s.

The outreach program must provide accurate and complete information that stakeholder groups and the general public can easily access and readily understand. For each fuel source a simple information packet should be produced describing the technology, development plans, outreach efforts, and environmental management strategies. Individual fact sheets that address specific issues or topics in more detail should also be produced as needed. The educational materials should be in printed form with professional graphics available to be distributed and used at conferences, workshops, and in general stakeholder discussions.

The materials should also be made available on the Internet and accessible to the general public. The Internet should be used as a major outreach tool by developing a dedicated website for each fuel source where project information, outreach events, research studies, and other information can be posted. The website can also provide an electronic forum for stakeholder comments and interactions. In addition to the websites, stakeholder list-serves can be used to communicate on specific issues or address specific questions to a select group of stakeholders.

4. Monitoring, evaluation, and program management.

The combination of established advisory committees, workshops and conferences, educational materials, and use of the Internet for stakeholder education and interaction will require coordination and project management. The impact of these activities on issue perception and stakeholder attitudes will change as issues mature, new information is developed, and as the media become involved. Stakeholder interaction and participation in outreach activities can also change with changing circumstances. Because the process can be fluid and the effectiveness of outreach activities is uncertain, program management must remain flexible and engage in monitoring and evaluation of activities in an ongoing basis. Monitoring and evaluation can take place as a regular part of committee feedback, evaluation forms completed at the end of workshops and conferences, informal interviews, and stakeholder surveys. A report of outreach activities including an evaluation of program effectiveness should be prepared for the task force on an annual basis.

RECOMMENDATIONS AND ACTION ITEMS

1. Establish an environmental advisory committee for unconventional fuels and necessary subcommittees to organize and coordinate stakeholder review and input to task force plans and decision making. We believe this kind of structure would avoid the need for Federal Advisory Committee Act (FACA) approval. For example, in the case of oil shale development, the advisory committee and its oil shale sub committee would provide input and guidance on the following plans and strategies:

- Environmental management plan that will review impacts on an industry wide basis and identify management strategies for industry and government and defines approaches for monitoring, analysis, and mitigation of environmental impacts.
- Carbon management plan to address CO_2 emissions
- Environmental research and development (R&D) plan to support mitigation of environmental impacts
- Water resource management plan

The advisory committee should have a separate operating budget to cover travel costs and independent consultants/advisors to conduct specialized analysis and monitoring. Funding must also provide for objective facilitators to manage the process and provide staff support to the advisory committee and its subcommittees. The committee should be large enough to include representation from all key stakeholder groups but not so large that decision-making and consensus-building becomes bogged down. Ideally the national advisory committee will include 10-15 people.

2. Convene advisory committee and necessary subcommittees to review and complete process design, work agendas, and initiate outreach efforts.

3. Organize and convene regional conferences or workshops to expand environmental feedback on development plans and engage a broader stakeholder population. These events and meetings should be planned and designed with stakeholder involvement from the appropriate members of the advisory and sub committees. For example, a regional stakeholders conference for oil shale and tar sands development could take place following the release of the PEIS in February or March of 2007. Preliminary discussions with the task force and relevant stakeholders have begun and Park City, Utah, has been identified as a possible location with the conference taking place in May or June 2007. The conference would include a discussion of relevant environmental issues, necessary research, possible mitigation strategies, and the stakeholder collaboration process.

4. Empower advisory committee and relevant subcommittees to craft a declaration of guiding environmental principles for each unconventional fuel source. These should be broad environmental principles to be used in policy-making, general decision-making, and for mitigation strategies. The guiding principles should define a general philosophy of environmental management and mitigation and give direction to more specific and detailed mitigation plans or best management practices. Ideally the declaration should reflect a consensus of the national advisory committee and include principles or statements such as:

- All development activities must meet or exceed federal, state, and local environmental standards and regulations
- Insure a no net loss of critical wildlife habitat through on-site mitigation and regional offsets.
- Employ best available technology to minimize water use and protect in-stream flows of existing streams, rivers, lakes.

5. Develop a list of off-site mitigation projects such as wildlife habitat enhancements, conservation land banks, or other efforts to offset environmental impacts at development sites. While every effort should be used to mitigate on-site impacts, the scale of cumulative impacts of industry-wide development may require that environmental offsets be created elsewhere in the region.

6. Use the Internet to inform and broaden stakeholder collaboration by setting up individual websites or stakeholder list-serves

for each unconventional fuel source. The websites could include ongoing updates on development activities, research findings, mitigation plans, and provide a forum for stakeholder commentary and interaction. The stakeholder list-serve can be used to make announcements or send specific messages to identified groups or individuals.

7. Develop educational materials for each fuel source. These materials should provide a brief overview of development plans, technologies, and outreach efforts. Individual fact sheets should also be developed and used to inform stakeholders, the media, and the general public. The educational materials can be distributed on the Internet and at stakeholder outreach activities such as workshops or conferences.

8. Monitor public opinion, perceptions, and stakeholder concerns to assess effectiveness of outreach program and make adjustments as needed. Monitoring and evaluation activities should include ongoing feedback from advisory committees and stakeholder activities. This could also include stakeholder interviews, focus groups, and informal surveys.

9. Complete annual report to the Unconventional Fuels Task Force describing outreach activities, documenting the collaboration process and the resulting conclusions and recommendations. The report should include discussion of the issues addressed, describe outreach activities, identification of the participants who were involved, evaluation of program effectiveness, and an overview of the lessons learned.

Figure II- 56. Environmental Outreach Advisory Subcommittee Relationship to Other Subcommittees

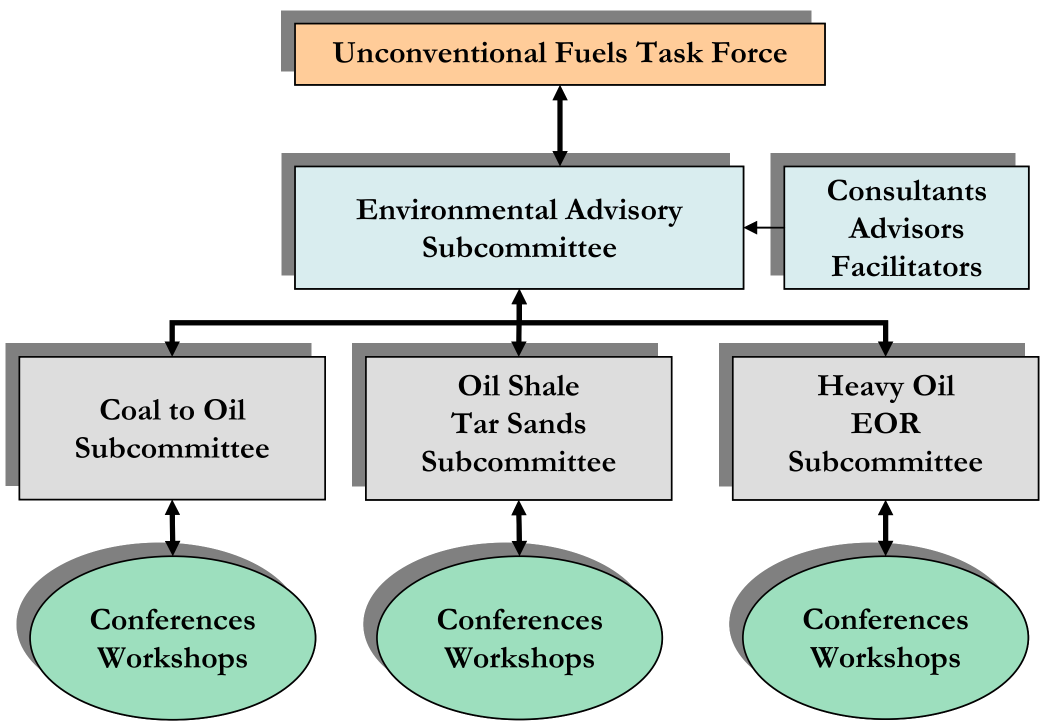


Figure II- 57. Environmental Outreach Activities Schedule

Environmental Outreach Activities	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Establish advisory comm./sub comm.															
Define declaration of guiding principles															
Establish individual websites															
Develop outreach materials															
Provide input to R&D plan															
Provide input to water & other resource management plans															
Organize & convene regional conference/workshops															
Monitor development & provide input on mitigation as needed															
Manage program/evaluate & report progress															

MARKETS
CROSS-CUT PLAN

MARKETS CROSS-CUT PLAN

GOALS AND OBJECTIVES:

The overall program goal is to accelerate the production of unconventional resources to achieve total production of 6 MMBbl/d by 2035. The objective of the markets cross-cut plan is to support the introduction of these unconventional fuels into future private and public markets.

To achieve this objective, the plan strategy is to align unconventional fuels production from multiple, dispersed unconventional fuels resources with refining and transport infrastructure and markets.

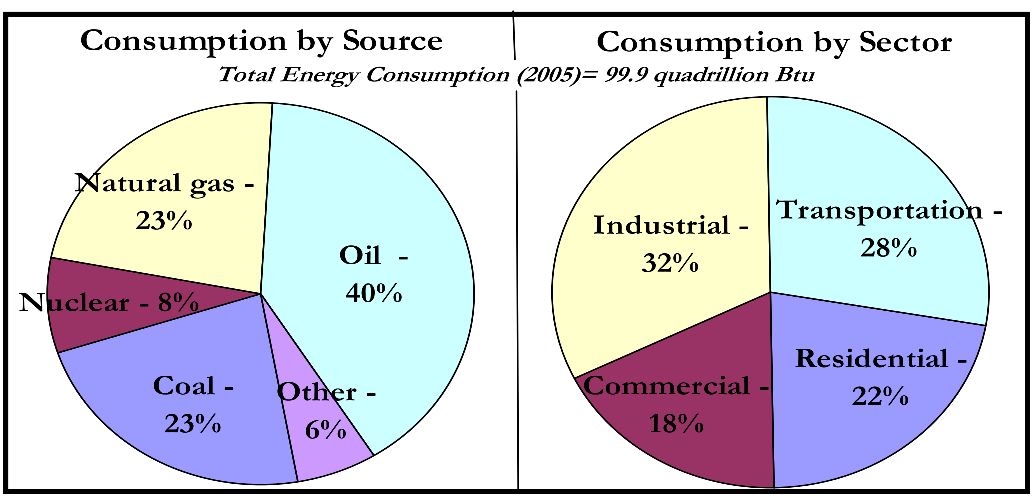
Key activities, discussed at the end of this plan, include:

- Analysis and assessment of current and potential public and private markets for unconventional fuels,
- Analysis and characterization of existing and planned transportation and refining infrastructure and capacities to accept new unconventional fuels feedstocks,
- Identify issues associated with dislocations between feedstocks, transport, refining, and end use markets, and
- Develop a plan that addresses any bottleneck that may hinder the smooth flow of unconventional fuels into commercial markets.

LIQUID FUELS MARKETS:

The United States economy is based on oil; it accounts for 38% of the Nation's energy demand, largely to support the transportation market (Figure II-58). Demand for motor fuels and for other fuels will continue to be concentrated at major population centers located throughout the United States. These markets have predictable requirements for gasoline, diesel fuels, and jet fuels that increase over time. The petroleum industry continually responds to these market demands, making changes in final products as required.

Figure II- 58. U.S. Economy Depends on Oil for Transportation[60]



Transition to a lead-free gasoline in the 1960's, for example, allowed the use of catalytic exhaust units to reduce vehicle emissions. In a similar manner, the industry is now completing a major effort to produce diesel fuels having a 97 percent reduction in sulfur content. The availability of this new fuel, in turn, will open up the market for diesel engines that have superior fuel-efficiency than comparable gasoline burning engines.

The capability to meet changing market demands with the volume of products needed is due to the vast infrastructure the petroleum industry has constructed to produce, transport, refine, and market its products. The physical attributes of the petroleum system, summarized in Table II-7, consist of 74,000 miles of crude pipelines, 149 refineries, 2,000 petroleum storage terminals, and a vast distribution network of pipelines, water carriers, motor carriers, and railroads.

Liquids fuels from unconventional sources must enter the petroleum system at the appropriate point and be delivered to a refinery where the liquids will be converted into normal commercial products.

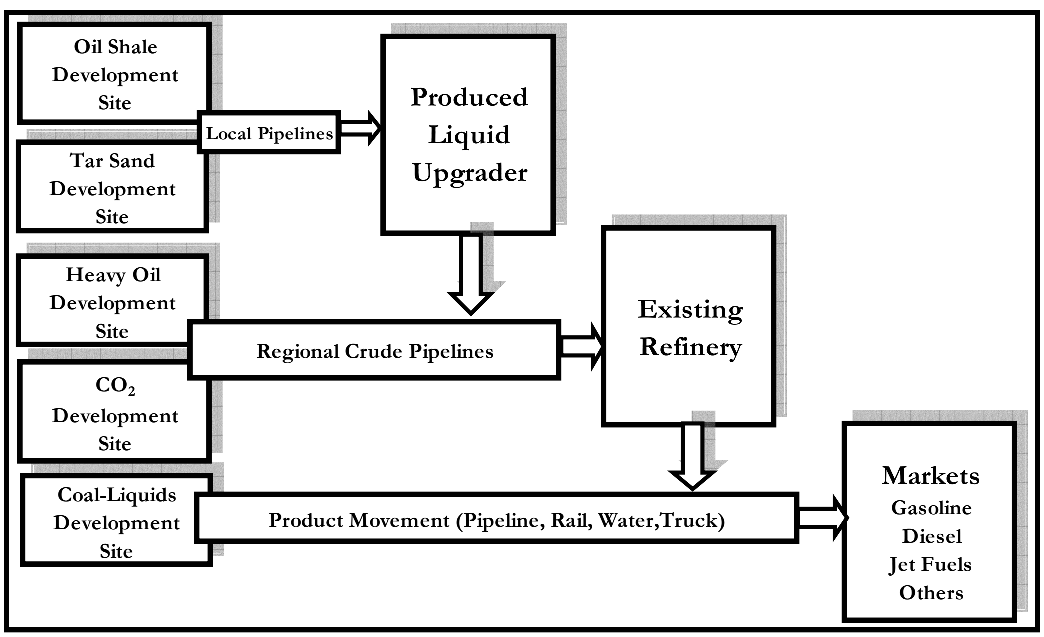
Table II- 7. Physical Attributes of the U.S. Petroleum System[61]

Components	Units
Production	602,000 Wells
Gathering Lines	30,000 Miles
Refineries	149 Refineries
Transmission Lines	74,000 Miles Crude Pipelines 74,000 Miles Product Lines
Storage	2,000 Petroleum Terminals
Distribution	616 Billion Ton Miles Pipelines 296 Billion Ton Miles Water Carriers 28 Billion Ton Miles Motor Carriers 17 Billion Ton Miles Railroads

Flow of Unconventional Liquids into Commercial Markets

This plan addresses liquids production from five unconventional sources: oil shale, tar sands, heavy oil, CO_2 oil recovery, and coal to liquids. From the development site, the liquids will enter the petroleum system along the route traced in Figure II-59.

Figure II- 59. Unconventional Liquids Flow



Liquids produced from oil shale and from tar sands development sites in Colorado, Utah, and Wyoming will need to be upgraded before they can be introduced into a regional crude pipeline. The upgraded liquid product can then be introduced into a regional pipeline and carried to an existing refinery where it will be converted to gasoline, diesel fuel, jet fuel, and other commercial products.

The initial shale oil and tar sand bitumen upgrading facility may be located on the development site or, when volume production is attained, at a regional upgrading facility. A regional upgrading facility would provide cost benefits to the developers, particularly the smaller producers, as well as provide environmental benefits to the region by reducing the number of point emission sources. The concept of a regional upgrade facility will be evaluated and presented to the developers for consideration as a cooperative effort that benefits the region as a whole.

Heavy oil and CO_2 oil development sites are at or near existing oil fields. Production and pipeline infrastructure are in place to transport this oil to existing refineries.

Coal to liquids plants using the Fischer-Tropsch process are designed to first gasify the coal. Individual gas streams are then recombined over a specific catalyst to manufacture fuels and chemicals. These products cannot be carried in a regional crude pipeline. Rather, the products will be moved by a product pipeline, rail, water, and/or truck for distribution into commercial markets.

Each unconventional fuel will impact the existing petroleum system differently. The major predictable impacts will be to the crude refineries and to the crude pipeline system.

Impact of Unconventional Fuels on Regional Refinery Operations

In a drive toward more efficient operations, the U.S. petroleum industry has been consolidating refinery operations for over two decades. In 1981, the U.S. had 324 separate refineries that processed 12.8 million barrels of oil per day (MMBbl/d). By 2004, the number of refiners had been reduced to 149, but refinery capacity had increased to 15.7 MMBbl/d[62]. Refinery expansion is expected to continue, with the majority of the expansion taking place at the existing refineries located along the Gulf of Mexico.

In addition to capacity expansion, West Coast and Gulf Coast refineries have gradually adapted to processing heavier, higher sulfur crudes by adding coking and cracking units. These refineries will continue to use highly specialized equipment needed to process specific crude types such as those produced from the nation's oil shale and tar sand resources.

Refineries in the Rocky Mountain area were constructed to process light, sweet crude oil that is produced locally. These refineries generally use atmospheric distillation to separate the oil into fractions according to the boiling points of the many compounds contained in the oil. These refineries adequately meet local requirements for gasoline, diesel, and jet fuels. They have not needed to add the more sophisticated coking and cracking units that will be needed to make final products from shale oil and tar sands that may be produced in quantity from the Rocky Mountain area.

Historically, the Rocky Mountain refineries are small (Table II-8). The largest, at 66,000 Bbl/d, is only one-eighth the size of the massive 557,000 Bbl/d ExxonMobil refinery located in Baytown, TX. Existing Utah and Wyoming refineries can probably absorb the first unconventional fuels production from demonstration plants, up to about 50,000 Bbl/d. However, continued growth of an unconventional fuels industry based on shale oil and tar sand liquids will soon outstrip existing regional refining capacity.

Table II- 8. Characteristics of Rocky Mountain Refineries[63]

Location	Capacity (MBbl/D)
Colorado	
Suncor Energy	60
Valero	27
Subtotal	**87**
Montana	
Cenex Harvest	55
ConocoPhillips	58
ExxonMobil	60
Montana Refining	8
Subtotal	**181**
Utah	
Big West Oil Co.	29
Chevron Texaco	45
Holly Corp Refining	25
Silver Eagle	10
Tesoro	58
Subtotal	**167**
Wyoming	
Frontier	46
Little America	24
Silver Eagle	3
Sinclair	66
Wyoming	13
Subtotal	**152**
Grand Total	**587**

It is not likely that industry will expand existing small refineries in the Rocky Mountain region and then construct new product pipelines to demand centers. It is far more likely that upgraded unconventional liquids will be transported by pipeline to modern refineries on the West Coast and along the Gulf of Mexico where final products can be produced and delivered to demand centers.

Impact of Unconventional Fuels on Pipeline Operations

The model to marry unconventional fuels production with existing refineries has been established by EnCana, one of Canada's largest oil sands producers, and ConocoPhillips, one of the largest refiners in the United States. Under a plan announced in October of 2006[64], the companies' will spend $10.7 billion over the next decade to transport oil from Canada's Alberta oil sands deposits to existing U.S. refineries located in Wood River, Ill and Borger, TX. The plan will connect the oil sands resources with the refineries using existing crude pipelines, expansion of existing crude pipelines, and the construction of new pipelines. Heavy oil processing capacity of the existing refineries will be expanded from 60,000 Bbl/d to 550,000 Bbl/d. Total throughput at the two refineries will increase from 450,000 Bbl/d to 600,000 Bbl/d.

The Alberta oil sands/U.S. refinery experience is expected to be repeated as stable production from unconventional fuels is reached in the United States.

This cross-cut plan anticipates that one new pipeline will be required by 2012 to move at least 500,000 Bbl/d of upgraded shale oil and tar sands liquids to refineries outside the Rocky Mountain region. Initial oil movement will likely be toward West Coast refineries. However, as the unconventional fuels industry continues to grow, one or more pipelines will be required to move 2 million Bbl/d to large demand centers in the Midwest and, through existing interstate lines, to the Nation's largest concentration of refineries along the Gulf of Mexico.

The construction of new pipelines will therefore need to be permitted on a timely basis to support a smooth industry expansion.

PHYSICAL CHARACTERISTICS OF UNCONVENTIONAL LIQUID FUELS

Unconventional liquid fuels may have different physical characteristics than the crude oil currently processed by the Nation's refineries. Significant differences, highlighted below, will be considered in the construction of the markets cross-cut plan.

Oil Shale

Shale oil is analogous to petroleum except for its high nitrogen and arsenic content. These are removed by upgrading which makes shale oil a premium quality refinery feedstock. Upgraded shale oil has almost no heavy residuals and is best suited to the production of diesel and jet fuels. However, the waxy nature of the feedstock allows the modern refiner to crack as deeply as desired to make either distillate fuels or motor gasoline.

Shale oil, whether produced from retorted oil shale at the surface or in-situ, will require upgrading to meet current pipeline specifications. Upgraded shale oil will then be refined to produce finished fuels and chemicals. Traditional upgrading typically involves catalytic hydrogenation to remove heteroatoms (nitrogen, arsenic, sulfur, metals, and others). Upgraded shale oil, like Canadian syncrude from oil sands, will be free of distillation residue and will contain low concentrations of nitrogen and sulfur. These characteristics coupled with high hydrogen content add market value to the product. Thus, the upgraded shale oil will likely sell at a premium to West Texas Intermediate (WTI) crude (the industry benchmark).

Typical yields of products produced from a surface retort (TOSCO) and that from the Shell Oil Company in-situ production process are compared with Brent and West Texas Intermediate crudes in Figure II-60. Cracking and hydrotreating or hydrocracking shale oil can give gasoline yields up to 60 percent.

In the Rocky Mountain, refineries have historically processed low-sulfur crude that has not required sophisticated coking and cracking units. These refineries will likely process the shale oil production from demonstration facilities, up to about 50,000 Bbl/d as discussed earlier. Using these local refineries, the straight-run gasoline yield (the volume percent that distills below 450 ^{O}F) will vary from 5 to 45 percent, depending on the oil shale extraction process (see Table II-9).

Figure II- 60. Typical Yields of Produced Shale Oil versus Crude Oil[65]

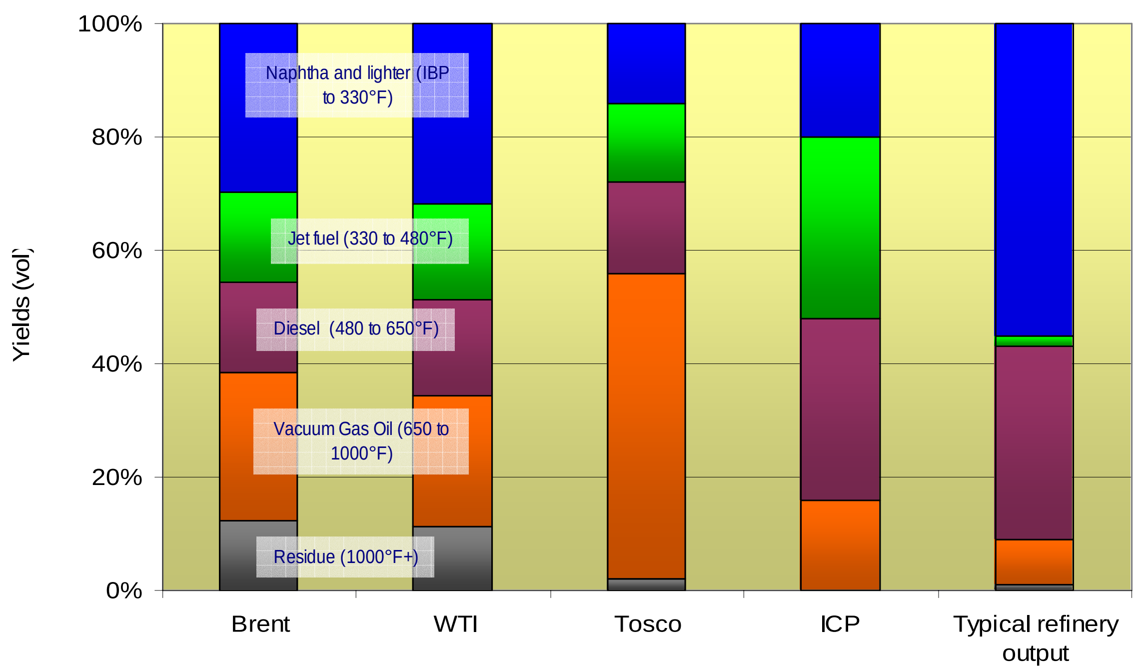


Table II- 9. Composition and Properties of Selected U.S. Shale Oils[66]

	Gas Combustion Retorting Process	Tosco Retorting Process	Union Oil Retorting Process	Shell ICP Process
Gravity, API	19.8	21.2	18.6	38
Pour Point, °F	83.5	80	80	
Nitrogen (Dohrmann), wt. %	2.14 ±0.15	1.9	2(KJELDAHL)	1
Sulfur (X-ray F), wt. %	0.6999 ±0.025	0.9	0.9 (P BOMB)	0.5
Oxygen (neutron act.), wt. %	1.6	0.8	0.9	0.5
Carbon, wt. %	83.92	85.1	84	85
Hydrogen, wt. %	11.36	11.6	12	13
Conradson carbon, wt.%	4.71	4.6	4.6	0.2
Bromine No.	33.2	49.5	Not available	
SBA wax, wt. %	8.1	Not available	6.9 (MEK)	
Viscosity, SSU.:				
100° F	270	106	210	
212° F	476	39	47	
Sediment, wt. %	0.042	Not available	0.043	
Ni, p.p.m	6.4	6	4	1
V,p.p.m.	6	3	1.5	1
Fe, p.p.m.	108	100	55	9
Flash (O.C.)°F	240		192 (COC)	
Molecular weight	328		306 (Calculated)	
Distillation				TBP/GC
450° at Vol. %	11.1	23	5	45
650° at Vol. %	36.1	44	30	84
5 Vol% at °F	378	200	390	226
10	438	275	465	271
20	529	410	565	329
30	607	500	640	385
40	678	620	710	428
50	743	700	775	471
60	805	775	830	516
70	865	850	980	570
80	935	920		624
90	1030			696
95	1099			756

Tar Sands

Tar sands, because of concentration and access, will likely be produced first in Utah. Canada's considerable experience with oils produced from a similar resource will take much of the learning curve out of processing and market applications. Like shale oil, it is necessary to upgrade the produced oil to a viable syncrude suitable for refinery feedstock.

Also like upgraded shale oil, this bottomless synthetic crude will require infrastructure to get it to refineries. Western refineries may be able to absorb some initial production. However, pipelines to West Coast and Gulf Coast refineries will ultimately be required.

The more complex refineries along the West and Gulf Coasts can handle a wide range of crude properties. However, many of these refineries were designed or modified to take advantage of price differentials for heavy, high-sulfur crude oils to provide higher positive economic returns for the refinery. This differential and economic investment will be a price barrier with which tar sand bitumum must compete as long as alternative heavy crude oils are available.

Coal Liquids

Both direct liquefaction and indirect liquefaction of coal to produce fuels were developed in Germany during WWII to fuel the German fighting machine. South Africa's SASOL has continued with the development of indirect liquefaction usually referred to as Fischer Tropsch (F-T). This process involves gasification of the coal through partial oxidation and recombination of the carbon monoxide and hydrogen over a catalyst to form high-cetane diesel fuels and high paraffin jet fuels. Cracking of these paraffin's and recombination catalysts can produce significant quantities of gasoline. Contaminants are removed from the gases before making the diesel and jet fuels allowing a nearly sulfur-free fuel.

Coal liquefaction via F-T makes quality finished fuels suitable for blending. This fuel will likely be sold as a premium diesel and jet fuel meeting the strictest sulfur standards. Some markets may use neat F-T products, but the most likely scenario is for blending with other finished fuels.

For carbon management strategies, an F-T process, when combined with an oxygen plant, produces a nearly pure carbon dioxide stream suitable for capture and use to increase oil production or for sequestration.

Overseas, China's largest coal producer is building a coal to liquids (CTL) plant based on a direct liquefaction process pioneered by the U.S. Department of Energy and further developed by Hydrocarbon Technology Inc. (now HTI). The direct liquefaction plant is currently under construction and, when complete, will produce 60,000 Bbl/d of mostly diesel and gasoline[67]. Direct liquefaction processes require further processing, but their advantage is in using about 30% less coal per barrel of liquid product. However, the additional energy inputs required for upgrading make indirect and direct liquefaction processes about equal in terms of energy efficiency.

Coal liquids will be produced at various sites around the country. Rail tankers, trucks, and barges will initially be used to send these fuels to appropriate markets. Depending on volume and economics, product pipeline connections may be made. Each production site will need to evaluate its infrastructure needs for moving CTL products to market.

Heavy Oil and CO_2 Enhanced Resource Recovery

The petroleum industry produces heavy oil and light oil from CO_2 injection operations every day. This produced crude is routinely transported to a refinery by existing pipelines. Incremental production due to this program will help to offset declining production in other parts of the field. But since the production and pipeline infrastructure is already in place, no further action is needed to assist market planning. However, assistance may be needed to permit pipelines that carry CO_2 from its point of origin to the oil field for enhanced recovery operations.

PROGRAM ELEMENTS

This cross-cut market plan is designed to help align unconventional fuels production with expected market demand. To achieve this goal, the plan will identify and address issues that may constrain the smooth flow of liquid fuels from a development site and its transport to final consumer products.

Table II- 10. Market Cross-Cut Plan Goals, Objectives, and Activities

Objectives	Strategies	Key Activities
Support the introduction of unconventional fuels into future private and public markets.	Align unconventional fuels production from multiple, dispersed unconventional fuels resources with refining and transport infrastructure and markets.	Evaluate fuels markets (private and public)
		Analyze potential of current and planned refineries to absorb expected production from unconventional fuels development
		Assess pipeline capacities and flows from production points to refineries
		Identify dislocations between feedstocks, transport, refining, and end use markets
		Support resource-specific subgroups in developing effective market strategies
		Develop an integrated plan to address bottlenecks

Table II-10 provides a summary of the goals, objectives, and activities for the markets cross-cut plan.

Strategy: The plan strategy is to align unconventional fuels production from multiple, dispersed unconventional fuels resources with refining and transport infrastructure and markets.

Rationale for Action: The government will have a major impact on the timing and scope of unconventional fuels development by implementation of this plan. As a part of its planning process, the Task Force will evaluate alternative ways it can assist the smooth flow of unconventional crude and products into commercial markets.

In addition to commercial markets, the Office of the Secretary of Defense has established a Clean Fuel Initiative and is moving to define and to develop a single Battlefield Use Fuel of the Future (BUFF) for use in ground vehicles and airplanes. To implement this initiative, the DoD is crafting a fuel specification that meets all its technical requirements for tactical vehicles. The Task Force will support the development of the fuel specification and work with industry to obtain fuels for military testing.

Coal liquids and oil products will enter the market in a manner that does not conflict with other unconventional fuels. The coal liquids will enter as finished products. They will be shipped from the point of production to end-use markets. Rail and/or barge availability must be evaluated for transport of these fuels to market since each site will be producing 50-80,000 bbl/d. Pipeline spurs may also link these plants to national product pipeline terminals.

Oil shale and tar sand produced and upgraded oils will compete for the same refining markets and transportation structure to those refining markets.

Market Cross-Cut Activities:

1. **Evaluate public and private fuels markets.** Building on the successful effort by the DoD to identify a specification that meets its fuel requirements, review other Federal and state markets that may be able to utilize unconventional fuels. Prepare legislation, as appropriate, that will use public markets to help stimulate the development of unconventional fuels.

2. **Analyze potential of current and planned refineries to absorb expected production from unconventional fuels development.** As a part of this task, determine the mix of refineries and refinery requirements needed to absorb expected production from unconventional fuels development.

3. **Assess pipeline capacities and flows from production points to refineries.** Evaluate the transportation capacity of pipelines to refineries that are likely to demand unconventional fuels.

4. **Identify dislocations between feedstocks, transport, refining, and end use markets.** Recommend government actions required to support the movement and refining of unconventional fuel.

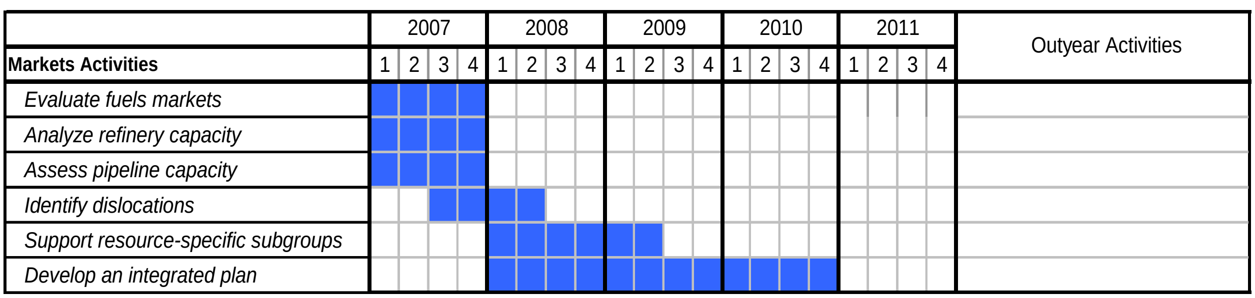
5. **Support resource-specific subgroups in developing effective market strategies.** Address resource-specific issues with moving unconventional fuels products to market.

6. **Develop a plan that addresses any bottleneck that may hinder the smooth flow of unconventional fuels into commercial markets.** Assess the location and rate of development of unconventional energy resources. Develop an integrated market plan that considers all developments and recommend government action that could support the movement of crude and products to commercial markets. This plan will include transportation of upgraded oils from shale and tar sands as well as finished fuels from coal-to-liquids plants.

<u>Market Cross-Cut Schedule:</u>

The markets cross-cut activities and schedule are provided in Figure II-61.

Figure II- 61. Markets Cross-Cut Activities and Schedule



INFRASTRUCTURE CROSS-CUT PLAN

INFRASTRUCTURE CROSS-CUT PLAN

GOALS AND OBJECTIVES

The Task Force's overall program goal is to stimulate private industry development of a domestic unconventional liquid fuels industry capable of producing over seven million Bbls/d by 2035 from the nation's oil shale, tar sands, coal to liquids, heavy oil, and CO_2 enhanced oil recovery resources.

This infrastructure cross-cut plan is designed to facilitate the availability of infrastructure (site access, utilities, product movement, refining, processing, and community) needed to support industry and community development and associated economic growth.

Specifically, the infrastructure cross-cut plan will facilitate development of:

- Public infrastructure needed to support community development, and
- Private infrastructure needed to support industrial unconventional fuels growth.

To achieve these objectives, the infrastructure cross-cut working group will use the following strategic approach:

- Encourage public and private input into the development of the cross-cut infrastructure plan,
- Identify existing infrastructure, both industry and community-related, that is currently available to support unconventional fuels production,
- Identify industry infrastructure that will be needed to support unconventional fuels development and quantify incremental infrastructure requirements,
- Identify community infrastructure that will be needed to support unconventional fuels development and quantify incremental infrastructure requirements.
- Prepare a plan that will facilitate the timely development of the incremental infrastructure.

INFRASTRUCTURE SUPPORT REQUIREMENTS

The scale of operations required to achieve a production goal of 7.6 MMBbl/d from the nation's unconventional resources by 2035 will require careful planning to ensure that the support infrastructure is in place when needed.

Each resource will have unique infrastructure requirements, depending on location and existing development, if any. Some of these requirements are:

- Improved roads and railroads will be needed to gain access to oil shale, tar sands, and coal liquids plants. Pipelines will need to be constructed to deliver CO_2 to the point of injection for CO_2 enhanced oil recovery.
- In-situ production of oil shale will require significant amounts of electricity or gas for heating the oil shale formation. Water availability will become an important regional infrastructure issue associated with oil shale and tar sand developments. Water may also be an issue in converting coal to liquids, depending on the location.
- New pipelines will need to be constructed to move shale oil and tar sand bitumen from the development site to refineries. If a dedicated product pipeline is not

available, coal liquids will need to be moved by truck, rail, and/or barge.

- Oil shale and tar sand developments in the sparsely settled western states will significantly impact the need for expanded community infrastructure. During the construction phase, there will be a need for temporary housing. Permanent housing then will be needed to support workers associated with operations and their families. As the population increases, the demand for community services will increase for electricity, water treatment, sewage disposal, schools, hospitals, and public roads.

This plan considers infrastructure support categories for each resource as well as across all of the unconventional resources:

- Industrial infrastructure to support the development site and the movement of products to market, and
- Community infrastructure needed to support the workers associated with the development and their families.

Industrial Infrastructure:

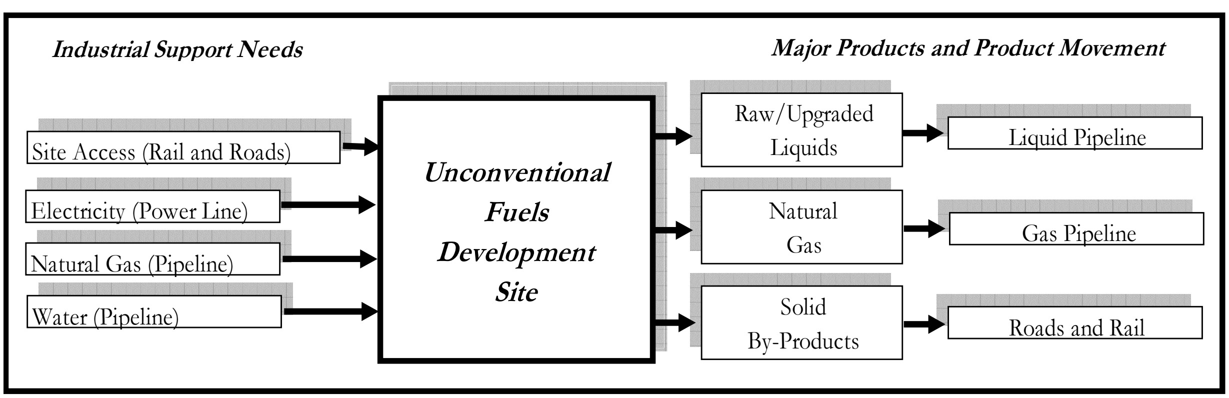
Development of any unconventional fuel site will require the common elements shown in Figure II-62. After the development site is selected, site access is obtained by rail and/or by road. Startup of operations will normally require small amounts of electricity, natural gas, and water drawn from local sources. As the operation expands, it will produce fuels (such as low Btu gases) that can be used to generate electricity on-site. Operations may also produce water as the result of mining and/or as a product of processing. An expanded development will reduce, and may eliminate, the need for outside sources of electricity, natural gas, and/or water.

Infrastructure must be in place to move products to appropriate markets, either for additional processing or for consumer end use. Pipelines, rail, and/or barges will be required depending upon the magnitude of product produced in one area.

Once the site is in production, raw liquids produced from oil shale and tar sand operations will be upgraded to remove heteroatoms (nitrogen, arsenic, sulfur, metals, and others). With these removed, the upgraded product can be moved by pipeline to a refinery for final processing into commercial fuels. Coal liquids will be produced on-site by the recombination of carbon monoxide and hydrogen over a catalyst to produce final products.

These can be moved to market directly by product pipeline, rail, and/or barge. Some processes may produce gas that may need to be upgraded to pipeline quality for shipment. Solid by-products will move by truck, rail, and barge, as appropriate.

Figure II- 62. Industrial Infrastructure Support Requirements



The Departments of Energy, Interior, Agriculture, and Defense (the Agencies) are preparing a draft Programmatic Environmental Impact Statement (PEIS) to identify the impacts associated with designating energy corridors on Federal lands in eleven western states. Energy corridors may contain oil, gas, and hydrogen pipelines and electricity transmission facilities. The Agencies are preparing the PEIS at the direction of Congress, as set forth in Section 368 of the Energy Policy Act of 2005[68]. Based upon the information and analyses developed in the PEIS, the Agencies will designate energy corridors by amending their respective land use plans. This effort will improve the ability to effectively permit new shale oil pipelines.

Initial development of Prototype Lease C-a in the 1970's demonstrated that access to industrial infrastructure support elements are reasonably close, even in a rural area. For this development, Rifle, Colorado, served as the railhead and received equipment for development of the tract. To gain access to the site, sixteen miles of road had to be widened, paved and straightened from the existing Piceance Creek road.

Initial electrical power was obtained 3 miles southwest of the site at Stake Springs Draw. Power was later generated on site. An 18-inch pipeline for natural gas was connected to an existing line one mile from the site. Initial water needs were obtained by an 18-inch water line constructed to the White River. Later water needs came from a combination of ground and surface sources.

Raw shale oil was intended to be upgraded on-site, but a later option was to move the raw shale oil to a regional upgrading facility. Upgraded liquid would be transported via a new 18-inch pipeline 30 miles to Rangely, Colorado. Pipeline quality gas was to be sold into existing pipeline infrastructure one mile from the site. Solid by-products were to be transported by truck to Rifle, Colorado, then by rail to final destinations.

This example shows that industrial development will initially use the existing infrastructure without the need for major upgrades. However, as production expands due to concurrent development, the regional infrastructure will need to be expanded significantly to manage increasing volumes of liquid fuels.

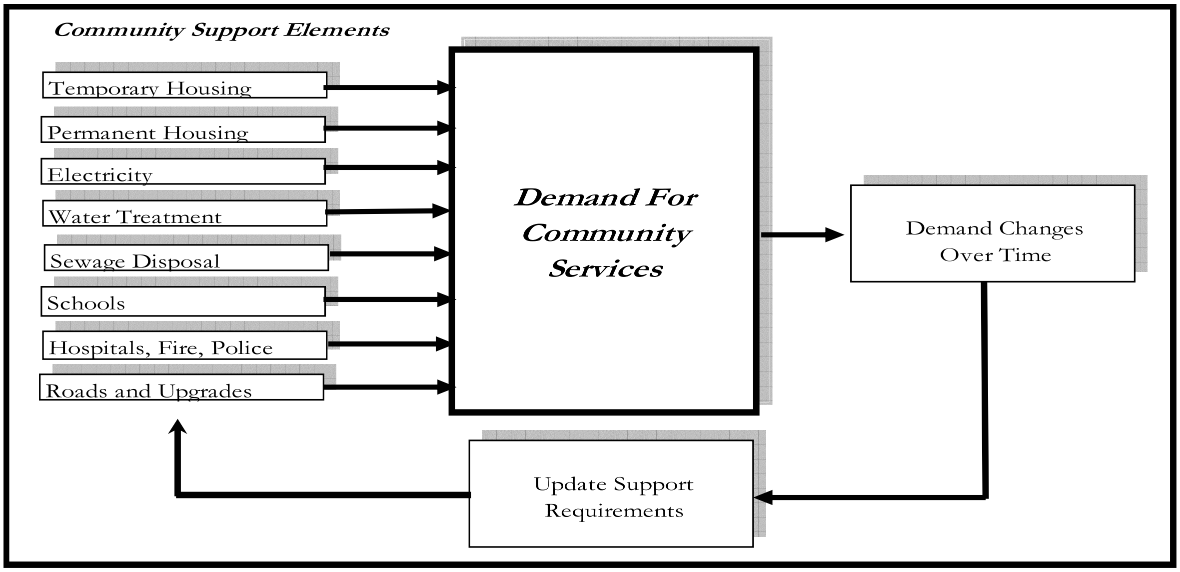
Community Infrastructure:

Population growth associated with unconventional fuels development can overwhelm small communities located in rural areas of the country. Rapid growth greatly expands the need for the types of community services shown in Figure II-63. All of these services require capital improvement expenditures long before tax revenues are available to help fund these improvements.

During the initial development of Prototype Lease C-a in the 1970's, Rifle, CO experienced a 33 percent increase in population in one year from, 2,250 to 3,000. Roads, schools, sewage treatment, and other city services were not sufficient to handle the change. Rifle needed about $6 million to make improvements. However, their bonding capacity was less than $1 million. A plan was developed and implemented to use Federal lease revenues augmented with industry funding to support a rapid buildup of the community infrastructure.

It is clear from this example that small, rural communities need help to support the population influx associated with unconventional fuels development. Under this plan, local and regional plans will anticipate infrastructure requirements and actions will be implemented to mitigate the effects of unconventional fuels development on local communities.

Figure II- 63. Community Infrastructure Support Requirements



INDUSTRIAL INFRASTRUCTURE SUPPORT REQUIREMENTS BY RESOURCE

The United States has a significant existing industrial infrastructure that is available to support unconventional fuels development. Of particular importance to the unconventional fuels program is the Nation's crude pipelines and refineries. The physical attributes of the petroleum system, summarized in Table II-11, consist of 74,000 miles of crude pipelines, 149 refineries, 2,000 petroleum storage terminals, and a vast distribution network of pipelines, water carriers, motor carriers, and railroads.

The location of the major infrastructure elements within the lower 48 states is given in Appendix A. Specifically, this appendix shows the nation's crude pipelines, natural gas pipelines, refineries, refined products pipelines, railroads, and the electric power distribution system. This infrastructure system is available to support unconventional fuels development. However, components of the system may need to be expanded depending on the location of development and the regional growth of the development.

Table II- 11. Physical Attributes of the Petroleum System[69]

Components	Units
Production	602,000 Wells
Gathering Lines	30,000 Miles
Refineries	149 Refineries
Transmission Lines	74,000 Miles Crude Pipelines 74,000 Miles Product Lines
Storage	2,000 Petroleum Terminals
Distribution	616 Billion Ton Miles Pipelines 296 Billion Ton Miles Water Carriers 28 Billion Ton Miles Motor Carriers 17 Billion Ton Miles Railroads

Oil Shale Industrial Support Requirements

Site Access – Much of the oil shale area is remote and gravel roads may currently provide access to the site to be developed. These roads will need upgraded or new roads constructed to handle the influx of heavy equipment needed to develop and sustain a shale oil industry. Rail staging terminals and main highway access routes also will be necessary to move needed equipment and supplies to the area in a rapid manner. Site access represents high-impact infrastructure requirements.

Electricity – Power lines cross the area to local communities and access to these lines is not viewed as a major infrastructure impact for surface developments. However, in situ production using electric heating to release the oils will have power requirements that will require the construction of an electric power plant near the development site.

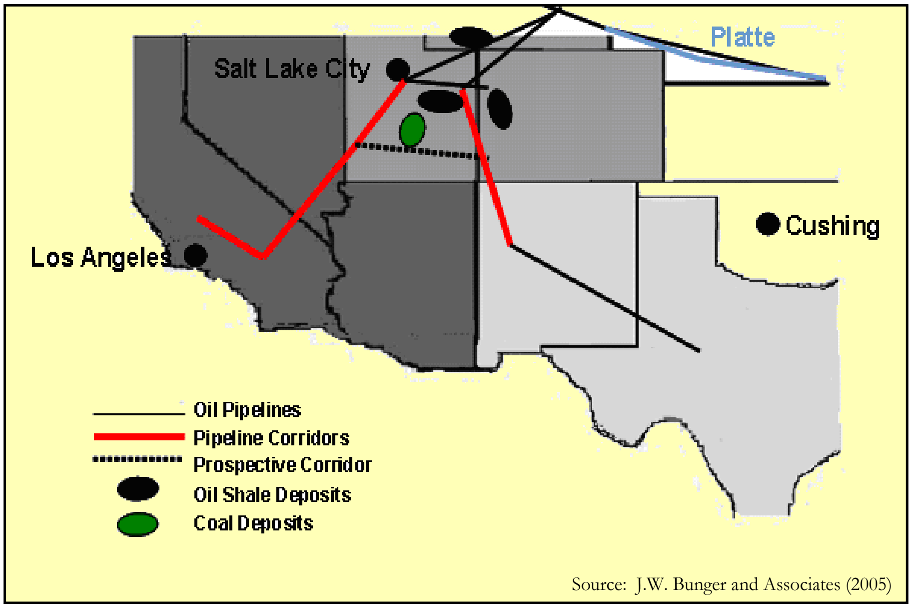
Natural Gas – Gas is produced throughout the area and its availability is not viewed as significantly impacting production of shale oil. Obtaining gas requires constructing connecting lines to these existing lines. Line sizes will be determined in the initial design of the facility.

Water – Retorts and shale oil upgrading facilities will require water. It is anticipated that much of the needed water can be obtained from surface water sources or from water contained in the shale oil formations. Each development will, of necessity, determine its water needs, its availability on its own leases, and the amount of makeup water that must be obtained prior to construction. An overlying issue will be the question of the availability of adequate water supplies to support large oil shale and/or tar sand commercial development. This scale of development may significantly increase the demand for water, with particular concerns about the demand on the Colorado River Basin. Because of the importance of this issue, a water resources cross-cut working group was established to evaluate regional requirements needed to support growing industries.

Crude pipelines and Product Movement – Produced liquids will be upgraded on site or shipped via local pipelines to a central upgrading plant. Upgraded shale oil will be shipped to local refineries until that market is saturated. New pipelines will then be required to connect into one of the major trunk lines shown in Appendix A.

For shale oil and for tar sands oil, the easiest route will be along existing pipeline corridors that connect resource locations south to New Mexico, west to Salt Lake City and northeast to the mid-continent area. Construction of a new pipeline in a potential corridor along I-70 to the Kern River gas pipeline corridor is possible in order to serve the California markets (Figure II-64[70]). This is an example of a regional overlay of infrastructure requirements that will be conducted to anticipate and support the permitting of pipeline additions and expansions needed to move the liquids to market.

Figure II- 64. Regional Shale Oil Pipeline Infrastructure Example



Tar Sands Industrial Support Requirements

Initial tar sands production will likely occur in rural areas of Utah. This initial production will mirror shale oil development infrastructure needs on a smaller scale. The tar sands must be mined, the oil extracted and upgraded, and the upgraded oil sent via pipeline to refineries.

Site Access – Rail terminals for receiving heavy equipment will be needed. Access roads to handle large, heavy equipment will likely need to be built or existing roads upgraded

Electricity and Natural Gas – Electricity and natural gas pipelines are nearby. Short runs of power lines and pipelines will need to be constructed.

Water – Utah's water usage will require similar systems to that described for shale oil. It is likely that new dams would be built to provide water storage for development. Water use and needs would have to be developed for each site where tar sands production is contemplated. Existing use may compete with oil shale or coal to liquids development for the same water, especially in the more arid western regions of the U.S.

Crude Pipelines and Product Movement – Tar sands liquids would likely be taken to centralized extraction facilities for upgrading to a pipeline quality product. New pipelines will then be required to connect into one of the major trunk lines shown in Appendix A.

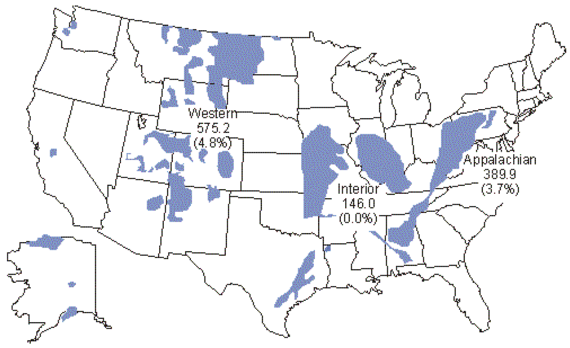
Coal Liquids Industrial Support Requirements

Coal is dispersed regionally throughout the U.S. Significant progress has been made in coal mining, both in its productivity and safety. These efforts would need to continue, including the opening of new mines, in order to meet the projected increasing demand for electric power generation and a new industry based on producing coal liquids.

Figure II-65 shows the regional distribution of coal resources throughout the country and increase in production over the prior year. To meet the goals for coal-to-liquids production, 35 percent more coal would have to be mined. Mature co-production plants designed for liquids production will each produce 50-80,000 Bbl/d of finished fuels.

Figure II- 65. United States Coal Distribution

(2004 Production in Millions of Short Tons per Year and Percentage Increase in Production over Prior Year)



Site Access – Since these plants will co-produce electricity and liquid fuels, it is likely that they would be situated near coal mines or railroads to facilitate heavy equipment and coal delivery. At these sites, the access infrastructure will likely be in place and impacts are anticipated to be low.

If the CTL plants are not sited near the mines, then coal transportation would become an important issue. Significant investments to upgrade and improve the western rail transportation system could be required since these rail lines are already congested. Additional barge capacity in the Midwest and eastern sections of the U.S. may also be required to meet additional coal demand. New roads would also be required to accommodate increased coal and service vehicles for these CTL plants.

Electricity and Natural Gas – Electricity will be generated on-site and natural gas is not part of the process. These infrastructure requirements will not impact this alternative fuel development.

Water – The CTL plant will use considerable amounts of water. This may present a problem if water is a scarce commodity at the site. However, technologies do exist to significantly reduce water use. Water lines will be required, and it is assumed that the plant would be situated where water is available.

Product Pipelines and Product Movement – The Fischer Tropsch (FT) process produces finished products. The coal liquids facilities will likely be scattered and the products shipped in product pipelines if those are available. Otherwise, tanker trucks, rail tankers and/or barge tankers will be required to move the products to appropriate markets. This would require special liquid handling terminals and increase the tanker transport from the site.

Heavy Oil Industrial Support Requirements

Site Access – Expansion of the heavy oil production will most likely occur near current production. Alaska heavy oil resources present unique site access issues, but the industry has learned to cope with those issues. Some of these resources are associated with public lands, both in Alaska and the other states. As such, some future production may require additional roads. Overall infrastructure for site access is low.

Electricity and Natural Gas – Current heavy oil production indicates that adequate electricity is nearby. Some increase in natural gas use would be expected using steam production technologies. Natural gas needs on the North Slope of Alaska could be met with pipelines from adjacent, gas-producing fields. Electricity and natural gas infrastructure needs are considered to have a low impact.

Water – Water is available for heavy oil production, therefore, infrastructure impacts associated with water will have little impact.

Crude Pipelines – Pipelines and right-of-ways are in place. Some local pipelines would be added to move the oil to main lines. New infrastructure needs are anticipated to be low.

CO_2 Enhanced Oil Recovery Industrial Support Requirements

CO_2 enhanced oil recovery infrastructure impacts mirror heavy oil impacts in every way except one. The CO_2 must be transported from its source to the oil fields. This will require planning for pipelines from a long-term, high-quality CO_2 source to these fields. This entails a special site access since there are few CO_2 lines except in the mid-continent where CO_2 is produced from carbonate reservoirs specifically for CO_2 enhanced oil recovery. CO_2 captured at a power plant would also have to be cleansed of impurities and pipelines built specifically to carry the CO_2 to the producing field. Significant CO_2 delivery infrastructure requirements are needed to support enhanced oil production.

COMMUNITY INFRASTRUCTURE SUPPORT REQUIREMENTS BY RESOURCE

Shale Oil Community Support Requirements

Development will create both temporary and permanent employment. Construction of the plants and urban communities create temporary employment in the sense that the job terminates with the completion of construction. Many of the temporary positions may be transitioned to permanent long-term employment if associated with the plant operations and supporting services. Actual labor requirements will depend on the mix of technologies chosen by industry to develop the resource and the timing of the development. However, as many as 100,000 direct and indirect new jobs could be created by the construction and operation of a 2.5 MMBbl/d shale oil industry.

Rural communities of Colorado, Utah, and Wyoming will need significant infrastructure to support an influx of 100,000 new people in the area. It is likely that many of the construction workers would remain for similar positions during operation of the shale oil plants. Higher numbers of construction workers would cause a need for temporary housing. Since development will be over a 30-year period, these 'temporary' construction workers may be able to move from site to site within the area. Unless they have a 'permanent' job with a company in the area, they are much more likely to consider themselves temporary from a housing viewpoint regardless of their tenure. Since some of these jobs may last for years, families may move in and leave when the job is finished creating swings in needs for school staff, medical, and other community services.

Tar Sands Community Support Requirements

Tar sands development in the U.S. will be relatively small compared with the development of Canada's oil sands or U.S. oil shale development. However, in rural Utah, tar sand production would have moderate to high impact on local community services. Demand will be high for temporary housing for construction activities, and significant growth of permanent residents will impact housing and the demand for community services.

Coal Liquids Community Support Requirements

The dispersed nature of the coal resources indicates that community infrastructure requirements would be very site specific. The CTL plants would likely be located near coal-producing regions to minimize transportation and other logistical costs. A wide swath of rural America from Appalachia through the Midwest, Great Plains and Rocky Mountains will directly benefit from the jobs and economic stimulus these plants will generate.

The impacts of CTL plants on local and regional communities would likely be very similar to the impacts generated during the construction and operation of conventional coal-fired power stations. For example, Southern Illinois University estimated in an economic analysis study that the 1,500-megawatt Prairie State electric generating facility in Washington County, Illinois, would inject more than $2.8 billion into the state economy, generate more than $200 million in new tax revenues for state and local governments, create more than 1,800 construction jobs per year during the building of the mine and plant, and create 450 permanent mine and power plant jobs.

These construction jobs would have a moderate impact on temporary housing, especially in sparsely populated areas of the U.S. The permanent employee growth would have low impact on permanent housing and other community infrastructure in almost any part of the U.S. Each specific site would need to be evaluated for these infrastructure needs.

Heavy Oil and CO_2 Enhanced Oil Recovery Community Support Requirements

The community infrastructure impacts from expanded production of these resources are expected to be low. Temporary workers may be in a community for drilling and work over of wells, but not in sufficient numbers that it would be unmanageable in almost any area. There will be few increases in the permanent workforce.

INDUSTRIAL AND COMMUNITY INFRASTRUCTURE SUPPORT REQUIREMENTS SUMMARY

Table II-12 summarizes the major infrastructure needs for each resource. Proper planning is required to assure that the infrastructure does not impede or thwart the goals for unconventional fuels development.

Shale oil and tar sand development, because of the remoteness of the sites and the small communities in Colorado, Utah, and Wyoming, will have significant impacts on infrastructure needs. Coal liquids plants will be spread about the country and have impacts on temporary housing and rails and roads, but other infrastructure should not inhibit growth of the industry. Oil production increases will have little effect on infrastructure except in unique situations. CO_2 pipelines will be a limiting infrastructure for CO_2 enhanced oil recovery and is listed as a site access issue. Heavy oil production in Alaska has unique infrastructure needs that the industry will have to address to produce this resource.

Table II- 12. Possible Limiting Infrastructure Elements for Unconventional Fuels Development

	Site Access	Utilities	Product Movement	Community Infrastructure
Shale Oil	Roads and railroads	Significant use of electricity, natural gas for in-situ operations Availability of water as the industry grows	Major new crude pipelines to connect with existing pipeline system	Significant need for temporary/permanent housing Significant increase in demand for community services
Tar Sands	Roads and railroads		New pipelines may have synergies with shale oil pipelines	Temporary/permanent housing Increased demand for community services
Coal Liquids	Roads, railroads, and barge capacity	Water availability could be a factor depending on location	Major truck, rail, or barge expansion capacity	Temporary housing needed for construction workers
Heavy Oil	Alaska could have special location considerations	Expanded natural gas use for steam generation		
CO_2 EOR	New pipelines to deliver CO_2 from source to field			

Table II- 13. Infrastructure Cross-Cut Plan Goals, Objectives, and Strategies

Goal: Facilitate availability of infrastructure (site access, utilities, product movement, refining, processing, and community) needed to support industry and community development and associated economic growth.

Objectives	Strategies	Key Activities
Facilitate public infrastructure development needed to support community development	Encourage public and private input into the development of the cross-cut plan	Develop a comprehensive stakeholder plan
Facilitate private infrastructure development needed to support industrial unconventional fuels growth	Identify existing industry and community-related infrastructure	Identify sites likely to be impacted by unconventional fuels development
	Identify industry infrastructure required to support unconventional fuels and quantify gaps	Define the industrial infrastructure needed to develop each resource
	Identify community infrastructure required to support unconventional fuels and quantify gaps	Define community infrastructure needed to support industrial development
	Prepare a plan that will facilitate the timely development of the incremental infrastructure	Prepare and implement a comprehensive infrastructure cross-cut plan

INFRASTRUCTURE PROGRAM ELEMENTS

Strategy

The infrastructure cross-cut plan is designed to facilitate the availability of public and private infrastructure needed to support unconventional fuels development. The goals, objectives, strategies, and key program activities are summarized in Table II-13 and further discussed below.

Rationale for Action

Comprehensive regional infrastructure plans will be developed to support orderly unconventional fuels development. Each resource has specific infrastructure needs, however many of these requirements overlap on a regional basis. A comprehensive plan considering all of the unconventional fuels will provide the greatest number of synergies among new infrastructure projects.

Each resource will be evaluated to determine infrastructure gaps that could impede growth of an unconventional fuel. Specific actions for each unconventional fuel are outlined as follows:

<u>Shale Oil and Tar Sands</u>

Initial tar sand and oil shale production will likely be in adjacent geographic areas and will likely compete for the limited refining capacity in this area. Pipelines for upgraded tar sand and oil shale produced oils do not exist. As refining capacity in the area is saturated, pipelines must be built to carry this upgraded oil to the refining markets on the West Coast and Gulf Coast. There is opportunity for synergy in the planning of the pipelines that will carry upgraded oils from both resources to assure that capacity exists for both.

- Determine water needs, availability and regional impacts.
- Develop pipeline infrastructure requirements and actions to ensure that needed infrastructure is in place to move upgraded shale oil and tar sands oil to refineries on the West and Gulf coasts.
- Develop database of possible production by true in-situ and evaluate the infrastructure resources required to heat reservoirs.

- Work with states and localities to determine support requirements.

Coal Liquids

Coal liquids plants will be located at various places around the country. Finished fuels will be produced and little competition for other product movement is envisioned. These plants will be dependent upon rail or barge to move raw coal to the plants and significant volumes of products to market. This assumes that most of these plants will not be sited near product pipelines. Chemical production from other resources located in the same general location could compete for rail tankers.

- Identify potential development sites.
- Evaluate potential sites for rail or barge access for coal delivery and for transport of products by pipeline, rail, and/or barge.
- Evaluate water requirements and regional impact, if any.

CO_2 Enhanced Oil Recovery and Heavy Oil

Produced petroleum will go into existing pipelines using existing industry infrastructure. These resources will not compete for infrastructure with any of the other unconventional fuels developments.

- Evaluate economic and physical capability to build pipeline from capture source to producing field.
- Evaluate impacts on natural gas use, and, in Alaska, evaluate special problems of transporting heavy oils to markets.

In addition to the resource-specific issues, there are regional issues to consider including:

Regional Water Issues

Water resources are scarce and significant planning will be required to assure sufficient water for individual and concurrent resource development. Water management will be addressed in the Water Management Plan and the results integrated into the infrastructure requirements of this plan.

Regional Carbon Management Issues

When heated, the unconventional resources will liberate carbon dioxide and other gaseous emissions. The cumulative loading on a regional basis will be addressed in the Carbon Management Plan and the results integrated into the infrastructure requirements of this plan.

Regional Market Issues

The crude and/or final products produced from unconventional fuels will each need to be transported to a commercial market. These issues will be addressed in the Markets Plan and the results integrated in the infrastructure requirements of this plan.

Infrastructure Cross-Cut Plan

Results from the resource-specific analyses will be incorporated into this infrastructure plan that also considers regional development issues. The following specific actions are planned:

- Develop comprehensive stakeholder plan
  - Identify the individual public and private organizations that will have a leading or significant role in developing this infrastructure.
  - Support infrastructure planning and development activities.
  - Develop recommendations, including legislation, for consideration and incorporation into the planning process.
- Identify sites likely to be impacted by unconventional fuels development and infrastructure currently available to support development.
  - Identify and assess existing infrastructure in the unconventional resource development areas.
- Define the industrial infrastructure needed to develop each resource including:

- Water needs and availability,
- Pipeline requirements for crude and product transport,
- Truck, rail, and barge capacity,
- Refinery and processing capacity,
- Pipeline requirements to move CO_2 from source to point of injection, and
- Utility requirements.

▪ Define community infrastructure needed to support industrial development for each unconventional resource including:

- Temporary and permanent housing
- Utilities (electricity, water, sewage), and
- Community services (roads, bridges, schools, hospitals, fire, police, and administration).

▪ Prepare and implement a comprehensive infrastructure cross-cut plan.

- Craft realistic development scenarios reflecting regional mix of resources, technologies, and development intensity.
- Identify additional industry development requirements to support integrated development scenarios.
- Identify additional community infrastructure requirements to support integrated development scenarios.
- Develop an integrated regional infrastructure support plan.
- Implement the infrastructure support plan.

Infrastructure Schedule

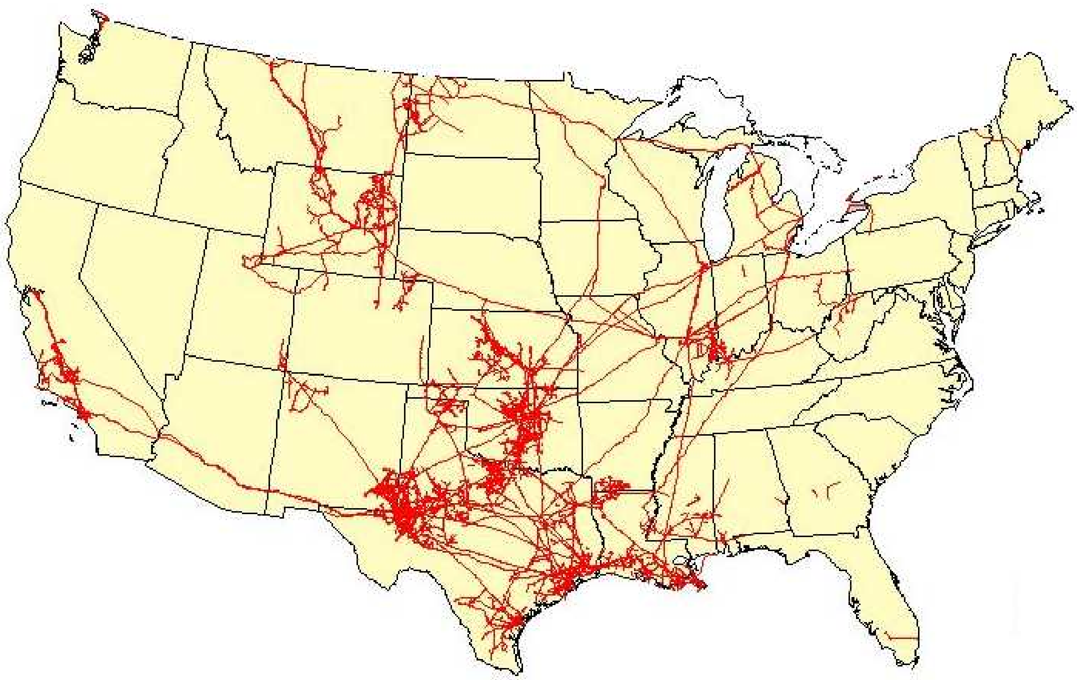
The infrastructure activities and schedule are provided in Figure II-66.

Figure II- 66. Infrastructure Cross-Cut Schedule

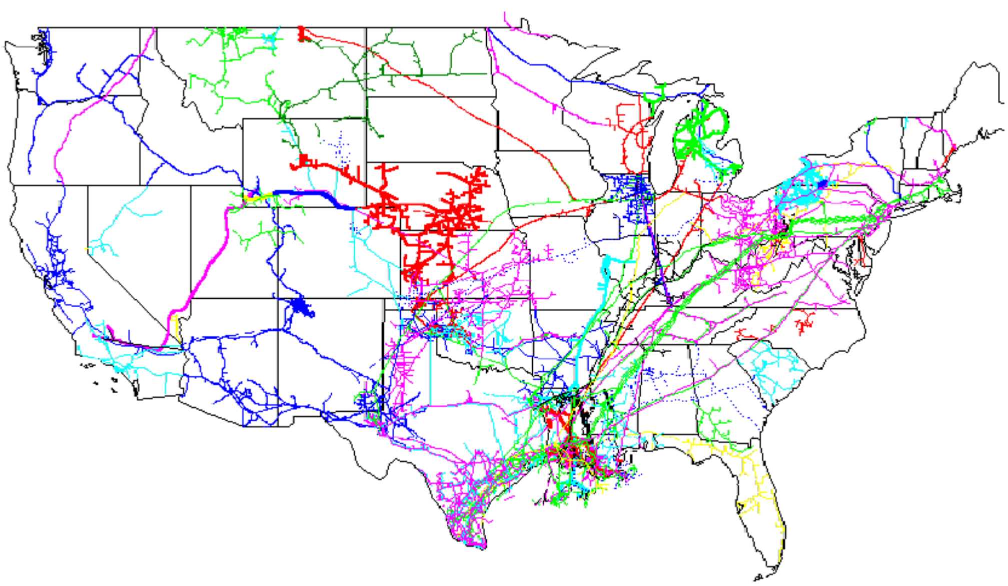
Infrastructure Activities	2007				2008				2009				2010				2011				Outyear Activities
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Prepare comprehensive stakeholder plan																					
Identify development sites																					
Define industrial infrastructure																					
Define community infrastructure																					
Prepare and implement plan																					Annual Plan Update

APPENDIX
EXISTING INDUSTRIAL INFRASTRUCTURE

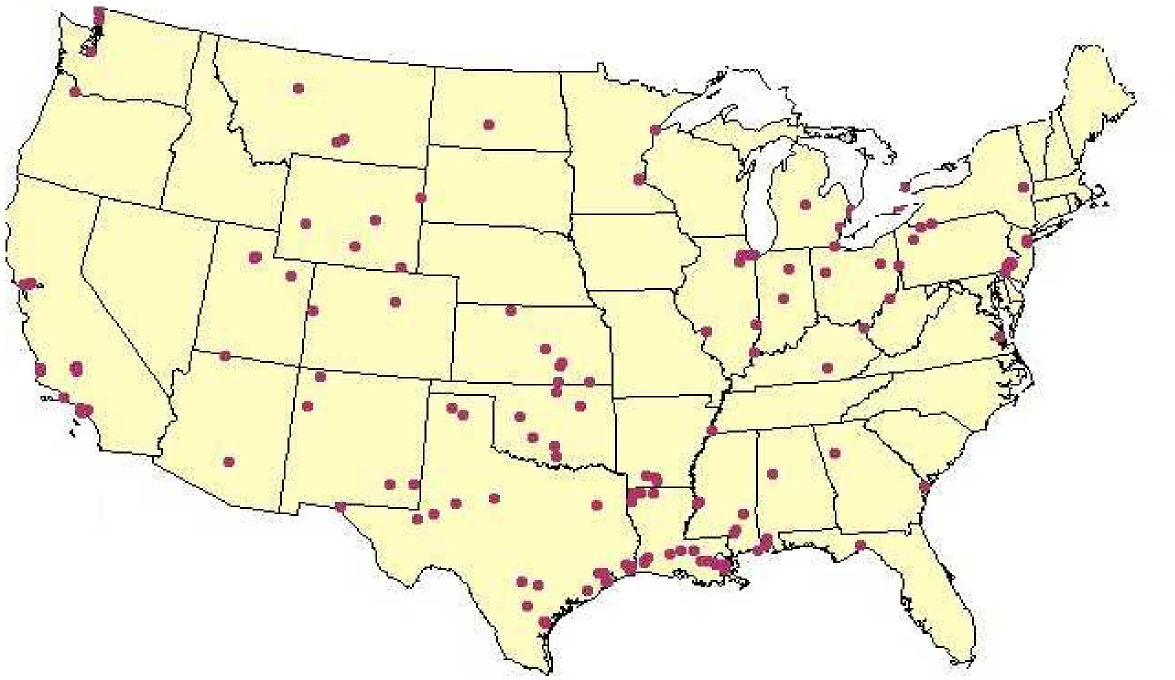
Crude Oil Pipeline Map



Natural Gas Pipeline Map

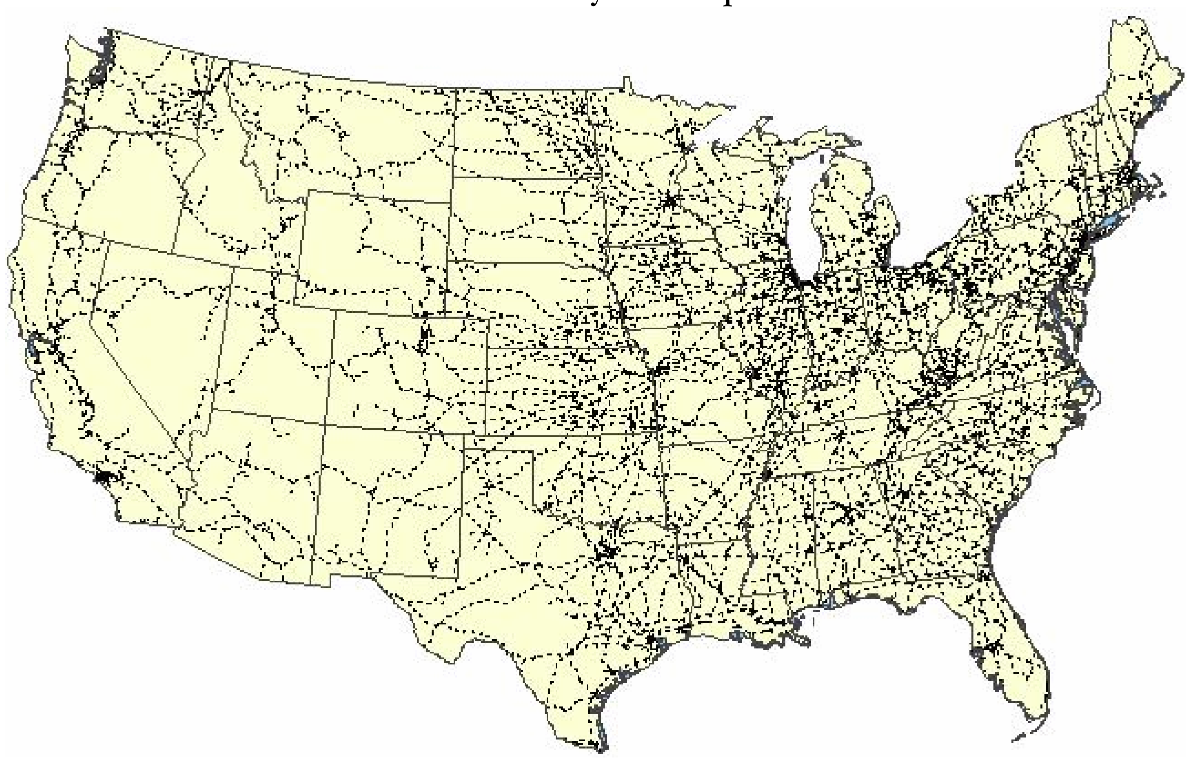


Location of U.S. Refineries

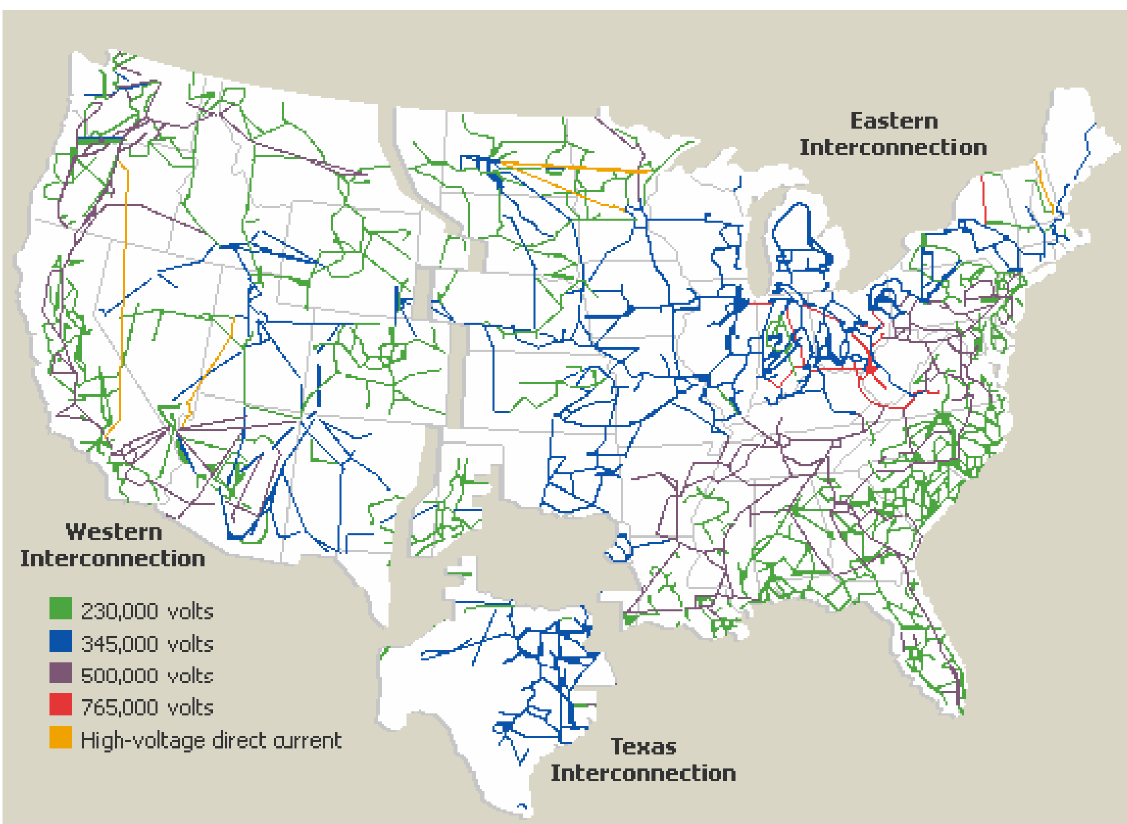


Refined Products Pipeline Map

Railroad System Map



Electric Power Distribution Site Map



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